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(54) **Title**: PROCESS FOR THE PRODUCTION OF PAPER

(57) **Abstract**: The present invention relates to a process for the production of paper comprising applying to a surface of a heated cylinder a release agent comprising a C_{16}-C_{20} fatty acid or salt thereof and an adhesive agent, applying a paper web to the surface of said cylinder, and removing said paper web from said cylinder. The invention also relates to use of a C_{16}-C_{20} fatty acid and an oil as a release agent for the production of a creped paper. Furthermore, the invention relates to a release agent comprising from about 2 to about 50% C_{16}-C_{20} fatty acid or salt thereof; from about 5 to about 50% alcohol; from about 0 to about 75% oil; from about 1 to about 5% surfactant and from about 1 to about 50% water. In addition, the invention relates to paper obtainable by the process as disclosed above.

PROCESS FOR THE PRODUCTION OF PAPER

Field of the invention

The present invention relates to a process for the production of a paper product by applying additives to a heated cylinder. The invention also relates to a release agent for controlling the release properties on said cylinder and the use thereof, and to a paper obtainable by the above process.

Background of the invention

Tissue products, such as facial tissues, toilet tissues, and kitchen roll towels, are linked by the common process by which they are generally manufactured, that is a process called creping. Creping is a process for mechanically compacting tissue paper in the paper machine direction and results in an increase in basis weight (mass per unit area) and other changes of the physical properties of the paper, such as stretch, softness and absorptivity. Tissue paper normally has a grammage of about or less than 25 g/m^2.

When a paper web has been formed from a furnish of cellulosic fibres, and optional additives, and most of the water has been removed through pressing, and sometimes also pre-drying, the web is usually transferred to a hot rotating drying cylinder, usually called a Yankee cylinder (or Yankee dryer). A Yankee cylinder is a large diameter drum which may be pressurized with steam to provide a hot cylinder surface. The at least partially wet web has a natural adhesion to the cylinder surface. However, this adhesion is often considered to be insufficient, in particular when the moisture content of the web is low. Therefore, the cylinder surface is usually treated with adhesives. These adhesives firmly adhere the wet web to the cylinder surface. The heat removes the moisture from the web, and when the web has reached the desired dryness, it is usually removed from the Yankee cylinder by use of a knife or a so-called doctor blade, that forces the web to separate from the Yankee cylinder since the following parts of the machine are moving slower. The increased adhesion achieved by the added adhesives improves the heat transfer allowing a more efficient drying of the web and a better creping.

Mono glazed (MG) paper is produced on the same type of cylinder, but in that case the paper is removed from the cylinder by the draw from the parts following, the pope roller or following drying cylinders, which have essentially the same speed as the cylinder without compacting on a knife, and thus the paper will not be creped.

A wide variety of adhesives are known in the art. Some examples of commonly used adhesives include polyvinylalcohol, polyacrylamide, polyethyleneimine, polyethylene oxide, polyamines, such as polyamine-epihalohydrin resins, polyamides and lignin sulfonate.

The adhesive(s) is/are usually combined with one or more release agents, such as hydrocarbon oils or mineral oils, to control the release of the web from the cylinder surface and also lubricate and protect the blade from excessive wear.

The whole process of contacting the web with the drying cylinder, firmly adhering this to the cylinder surface using adhesives and other additives like release agents, drying the web and subsequently mechanically removing the web from the cylinder surface using a blade, is a process of less than one second. The dwell time, i.e. the time period that the web is adhered to the Yankee cylinder, is generally from about 300 to 1000 msec. The time of removing the web from the Yankee cylinder using the blade is generally less than one millisecond.

The purpose of the creping process is to give the tissue paper desirable textural characteristics, such as softness, strength and bulk (i.e. the inverse of the density), and a creped surface structure.

While the creping process is required to create the desirable creped surface structure and textural characteristics of the tissue paper, it may also create significant damage to the integrity of the web. The impact of the doctor blade on the web results in rupture of some of the fibre-to-fibre bonds within the web leading to separation of the fibres, and sometimes even partial rupture of individual fibres, causing dust formation.

Dust formation has a negative impact on the entire handling of the tissue paper, including use by the consumer. Dust separated from the web will have a tendency to deposit on surfaces. The paper machine as well as all equipment used in the conversion of the web into the final tissue product is thus subjected to deposition of air-borne dust, such as fibres and fibre fragments, which is a significant disadvantage in the production process. The dust also has a negative impact on health and fire safety.

The process for production of paper is then a balance between adhesion and release, and avoiding dust formation. It would be advantageous to be able to provide a process for

production of paper wherein the release of the web from the cylinder is quick, uniform and without formation of dust, and without a negative effect on the quality of the formed paper.

US 4,309,246 discloses a process wherein an adhesive solution is used in the manufacturing of a creped paper. However, uniform release of the paper product is not achieved.

There clearly is a need for an improved process for the production of paper providing a uniform release of the paper product with reduced dust formation. Thus, one intention of the invention is to provide an improved release agent.

Summary of the invention

An object of the present invention is to alleviate the above problems and drawbacks, and to provide an improved process for the production of paper providing a uniform release of the paper product with reduced dust formation.

According to a first aspect of the invention, this object is achieved by a process for the production of paper comprising:
(i) applying to a surface of a heated cylinder, a release agent comprising a C_{16}-C_{20} fatty acid or salt thereof, and an adhesive agent;
(ii) applying a paper web to the surface of the cylinder; and
(iii) removing the paper web from the cylinder.

According to one embodiment, an oil, for example a vegetable oil, is comprised in the release agent, for example in an amount from about 0.5 to about 75 %, for example from about 20 to about 75 %, such as from about 30 to about 70 % or from about 40 to about 65 % or from about 45 to about 55 %.

A second aspect of the invention relates to the use of a C_{16}-C_{20} fatty acid or a salt thereof and an oil as a release agent for the production of creped paper.

A third aspect of the invention relates to a release agent comprising from about 2 to about 50% of a C_{16}-C_{20} fatty acid or salt thereof; from about 5 to about 50% of an alcohol; from about 0 to about 75% of an oil; from about 1 to about 5% of a surfactant and from about 1 to about 50% of water.

According to one embodiment, the invention relates to a release agent comprising from about 2 to about 50 % of a C_{16}-C_{20} fatty acid or salt thereof and an oil in an amount from about 0.5 to about 75 %.

According to one embodiment, the amount of oil in any of the aspects of the invention ranges from about 20 to about 75 %, such as from about 30 to about 70 % or from about 40 to about 65 % or from about 45 to about 55 %.

A fourth aspect of the invention relates to paper obtainable by the process as disclosed herein.

Other features and advantages of the present invention will become apparent from the following description of the invention.

Detailed description of the invention

By the term "cylinder", as used herein, is meant a cylinder, usually a heated cylinder, which can be used for the production of creped paper or MG paper. The cylinder may be heated to a surface temperature between about 60 and about 130 °C.

The release agent of this invention comprises a C_{16}-C_{20} fatty acid or salt thereof. The term "C_{16}-C_{20} fatty acid", as used herein, means a fatty acid having 16 to 20 carbon atoms. Examples of suitable C_{16}-C_{20} fatty acids include palmitic acid, stearic acid and oleic acid, preferably palmitic and stearic acid. Examples of suitable salts of such fatty acids include sodium, potassium, calcium or magnesium salts. Examples of suitable amounts of fatty acid or salt thereof in the release agent are from about 2 to about 50 wt% of a C_{16}-C_{20} fatty acid or salt thereof.

The release agent may also comprise an alcohol, e.g. a diol or triol. Examples of suitable alcohols include ethylene glycol, propylene glycol and glycerol. Examples of suitable amounts of alcohol are from about 5 to about 50 wt%.

The release agent may also comprise an oil, e.g. a vegetable oil. Examples of suitable oils include palm oil, soy bean oil, rape seed oil and sunflower oil. Examples of suitable amounts of oil are for example from about 0.5 to about 75 %, for example from about 20 to about 75 %, such as from about 30 to about 70 % or from about 40 to about 65 % or from about 45 to about 55 %.

According to one embodiment, the release agent may also comprise a surfactant. Examples of suitable surfactants include non-ionic surfactants, e.g. fatty alcohol ethoxylate. Examples of suitable amounts of surfactants are from about 1 to about 10 wt%, for example from about 1 to about 5 wt%.

According to one embodiment, the release agent may comprise water and examples of suitable amounts of water are from about 1 to about 50 wt%, for example from about 1 to about 20 wt% based on the surface area of the paper.

According to one embodiment, the release agent can be applied in an amount of from about 0.5 to about 50 mg/m^2, for example from about 1 to about 10 mg/m^2, based on the surface area of the paper. According to one embodiment, the adhesive agent is applied in an amount of from about 0.5 to about 50 mg/m^2, for example from about 1 to about 10 mg/m^2, calculated based on the surface area of the paper. According to one embodiment, the fatty acid or salt thereof can be applied in an amount of from about 1 mg/m^2 to about 20 mg/m^2, for example from about 2 to about 10 mg/m^2, based on the surface area of the paper.

According to one embodiment, the adhesive agent of this invention may comprise a synthetic polymer. Examples of suitable synthetic polymers include cationic, non-ionic, anionic and amphoteric organic polymers, preferably a cationic polymer. Examples of suitable non-ionic polymers include polyvinylalcohol, polyacrylamide and polyethylene oxide. Examples of suitable cationic polymers include cationic polyacrylamides, polyethyleneimine, and cationic polyamines, e.g. polyamine-epihalohydrin resins.

According to one embodiment, the adhesive agent and release agent are preferably applied before applying the wet paper web to the heated cylinder. By this procedure, the release agent and adhesive agent will already be present on the cylinder before applying the paper web to said cylinder, wherein the adhesion of the paper to the cylinder will be controlled and the cylinder will be lubricated, causing less wear of the cylinder and knife, less formation of dust and an improved paper product.

According to one embodiment, the release agent and/or adhesive agent is applied by spraying. One advantage with direct spraying of the release agent and/or adhesive agent onto the Yankee cylinder surface or on the paper surface before contacting the Yankee cylinder surface is that less amount of the release agent is needed than if added to the furnish. Preferably, the release agent and/or adhesive agent is applied onto the heated cylinder.

According to an embodiment, the paper web is removed from the cylinder by a knife to produce a creped paper product. Such a knife may be a doctor blade.

The invention is further illustrated in the following Examples which, however, are not intended to limit the same. Parts and % relate to parts by weight and % by weight, respectively, unless otherwise stated.

Example 1

A comparison between two different release agents, one comprising calcium stearate and the other comprising 95 % soy bean oil, was made.

Water dilutions of 0,3% polyamidoamine epichlorohydrin resin (Eka Soft B15) (as dry) in combination with different amounts of two release agents, 50% calcium stearate dispersion (Eka LC RG 50/2 TC) and Eka Soft R45, a formulation consisting of 95 % soy bean oil and 5 % surfactant (as a reference) were tested on a peel tester. The peel test is a method to test different adhesive agents and release agents. It is performed by attaching a strip of absorptive material to a heated metal plate in a reproducible way by using adhesive agents and release agents, drying the adhered strip and pulling it off at an angle of 90^0 with constant speed, while measuring the force needed to pull off the strip. The peel force for a given adhesive/release agent combination is reported in N/m. The results are shown in Table 1 below.

Table 1

No.	Eka Soft B15 (% active)	Release product	Release (% active)	Peel strength (N/m)
1	0.3	-	0.0	32.4
2	0.3	Eka LC RG 50/2 TC	0.075	18.2
3	0.3		0.125	14.0
4	0.3		0.25	9.1
5	0.3		0.5	6.6
6	0.3	Eka Soft R45	0.5	21.3
7	0.3		1.0	14.5
8	0.3		2.0	13.2

As can be seen in the above table, the release agent comprising calcium stearate showed much better release efficiency than a release agent comprising 95 % soy bean oil and 5 % surfactant.

Example 2

The release effect for three different release agents comprising C_{16}-C_{20} fatty acid salts, calcium stearate, calcium palmitate and sodium stearate, was compared.

The formulations all contained 4 % of the C_{16}-C_{20} fatty acid salt, 12 % glycerol, 0.3 % nonionic surfactant, C_{13} fatty alcohol ethoxylated with 7 moles of ethyleneoxide (Marlipal® O13/79) and water. The release effect has been compared on the peel tester for various amounts of release product and a fixed amount of 0.3 % active Eka Soft B15, see table 2 below. Peel strengths are measured in N/m.

Table 2

No.	Eka Soft B15 (% active)	Fatty acid salt	Release (% active)	Peel strength (N/m)
1	0.3	-	0.0	36.1
2	0.3	Ca-Stearate	0.32	16.2
3	0.3		0.64	10.1
4	0.3		1.28	5.4
5	0.3	Ca-Palmitate	0.32	13.7
6	0.3		0.64	10.5
7	0.3		1.28	5.6
8	0.3	Na-Stearate	0.32	14.1
9	0.3		0.64	9.1
10	0.3		1.28	3.5

As can be seen from the table above, it is clear that the release effect is comparable for the different fatty acid salts.

Example 3

The following formulation was run together with Eka Soft B15 on a full scale tissue machine:

Inventive formulation

1.2 % (Marlipal® O13/79)
28.8 % Soy bean oil
30.0 % Glycerol
20.0 % Tap water
20.0 % Eka LC RG 50/2 TC

When comparing the above formulation with Eka Soft R95 (95 % mineral oil and 5% nonionic surfactant) and a constant addition of EkaSoft B15, it was found that better runability, reduced dusting and the same paper quality was achieved at lower addition rate of the above formulation compared to R95. The addition rates in this trial are shown in table 3.

Table 3

Eka Soft R95	5 mg/m^2
Inventive formulation	3,5 - 4 mg/m^2

Example 4

The release effect for lauric acid, palmitic acid; and calcium stearate in conjunction with soybean oil was compared.

Lauric acid and palmitic acid formulations were prepared according to the following recipe:

1 g Berol 828 (Ricin oil ethoxylate containing 15 EO (ethylene oxide)) 9.0 g fatty acid (lauric acid or palmitic acid respectively)

90 g water

Emulsions of the respective formulations containing 9 g lauric acid or 9 g palmitic acid were prepared by heating while stirring. Thereafter, emulsifying with an Ultra Turrax was performed prior to rapid cooling with running water.

A formulation of calcium stearate and soybean oil was prepared according to the following recipe:

0.5 g Berol 828 (Ricin oil ethoxylate containing 15 EO (ethylene oxide)

5 g soybean oil

10 g 50 wt% calcium stearate

84.5 g water

An emulsion was performed by heating while stirring. Thereafter, emulsifying was performed with an Ultra Turrax prior to rapid cooling with running water.

Water dilutions of 0.3 wt% dry (active) polyamidoamine epichlorohydrin resin (Eka Soft B15) and the formulations of lauric acid, palmitic acid, and calcium stearate+soybean oil were prepared and tested on a peel tester as described in example 1.

Table 4

No	Eka Soft B15 (% active)	Release product	Release (% active)	Mean peel strength (N/m)
1	0.3	Lauric acid	0	28.7
2	0.3		0.15	22.3
3	0.3		0.3	14.6
4	0.3	Palmitic acid	0	28.7
5	0.3		0.15	19.1
6	0.3		0.3	13.1
7	0.3	Calcium stearate+soybean oil 50/50% mix	0	28.7
8	0.3		0.15	16.6
9	0.3		0.30	6.5

As can be noted from the tests above, it can be clearly seen the combination of calcium stearate and soybean oil has an improved peel strength value in view of for example (C16) palmitic acid.

CLAIMS

1. A process for the production of paper comprising:

-applying to a surface of a heated cylinder, a release agent comprising a C_{16}-C_{20} fatty acid or salt thereof, and an adhesive agent;

-applying a paper web to the surface of said cylinder; and

-removing said paper web from said cylinder.

2. A process according to claim 1, wherein said release agent further comprises a diol or a triol.
3. A process according to claim 1 or claim 2, wherein said release agent further comprises a vegetable oil.
4. A process according to any one of claims 1 to 3, wherein said release agent further comprises a nonionic surfactant.
5. A process according to any one of claims 1 to 4, wherein said release agent is applied in an amount of from about 0.5 to about 50 mg/m^2, calculated based on the surface area of the paper.
6. A process according to any one of claims 1 to 5, wherein said fatty acid or salt thereof is applied in an amount of from about 1 mg/m^2 to about 20 mg/m^2, calculated based on the surface area of the paper.
7. A process according to any one of claims 1 to 6, wherein said adhesive agent comprises a cationic synthetic polymer.
8. A process according to any one of claims 1 to 7, wherein said adhesive agent is applied in an amount of from about 0.5 to about 50 mg/m^2, calculated based on the surface area of the paper.
9. A process according to any one of claims 1 to 8, wherein said C_{16}-C_{20} fatty acid or salt thereof is a sodium, potassium, calcium or magnesium salt of a C_{16}-C_{20} fatty acid.
10. A process according to any one of claims 1 to 9, wherein said paper web is removed from said cylinder by a knife to produce creped paper.
11. A process according to any one of claims 1 to 10, wherein the adhesive agent and release agent are applied before applying the paper to the heated cylinder.
12. A process according to any one of claims 1 to 11, wherein said release agent is applied by spraying.
13. Use of a C_{16}-C_{20} fatty acid or salt thereof and an oil as a release agent for the production of creped paper.

14. Release agent comprising from about 2 to about 50% C_{16}-C_{20} fatty acid or salt thereof; from about 5 to about 50% alcohol; from about 0 to about 75% oil; from about 1 to about 5% surfactant and from about 1 to about 50% water.
15. Release agent comprising from about 2 to to about 50% C_{16}-C_{20} fatty acid or salt thereof, and an oil in an amount from about 0.5 to about 75 %.
16. Paper obtainable by a process according to any one of claims 1 to 12.

INTERNATIONAL SEARCH REPORT

International application No
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A. CLASSIFICATION OF SUBJECT MATTER
INV. C08K5/09 B31F1/12 D21H17/14 D21H21/14
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)
C08K B31F 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 practical, search terms used)
EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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

[X] See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
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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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