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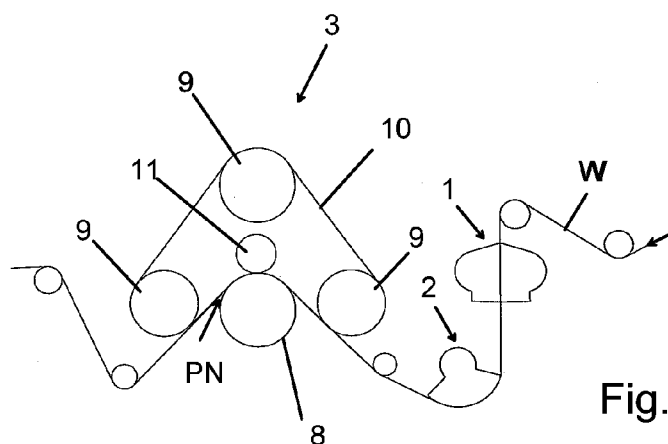


Fig. 1

(57) Abstract: The invention relates to a method for surface sizing a fibrous web. The method comprises bringing a fibrous web to a surface sizing station, at which a surface size, which has its dry matter content preferably within the range of 20-30%, is applied to at least one side thereof as spray application. The application stage is followed by conducting the fibrous web, optionally by way of a surface sizing nip and/or optionally by way of a separate drying stage, to a metal belt-equipped processing unit, which includes a metal belt adapted to circle around at least one guide element, outside said metal belt being provided at least one backing element establishing a contact face with the metal belt, such that between the metal belt and the backing element is provided an extended web processing zone, the web to be processed being conducted therethrough.



Method and apparatus for surface sizing a fibrous web

The present invention relates to a method as set forth in the preamble of claim 1 and an apparatus as set forth in the preamble of claim 3 for surface
5 sizing a fibrous web.

The term surface size refers usually to an aqueous starch mixture, which is spread on the surface of board or paper and pressed within the web for example in a nip between rolls. The surface size is used for increasing web
10 strength. The surface size also improves the surface properties and printability of paper. In addition to starch, the surface size mixture may contain many additives and, in some instances, it is also possible to employ latex as a binder in the size. In principle, this invention can be applied to all size mixtures and a variety of fibrous webs. In the production of some board
15 grades, such as a liner and fluting used for corrugated board, the strength of a product is one of its most essential properties. Since the surface size can provide a considerable improvement in bending strength and surface strength, among others, it is desirable to use large amounts of surface size for these board grades. At the moment, the largest application amount is
20 achieved by puddle application equipment, but its highest possible running speed is too low for today's demands. Thus, the modern board machines employ film transfer application for surface size spreading. In film transfer application, the surface size is spread first on the surface of a film transfer roll, by which it is transferred onto the web. The board machines often
25 employ a concurrent two-sided application, whereby the web proceeds across a nip established by two film transfer rolls. Each roll has its own application beam. Such equipment enables reaching, for one surface of the web, a reasonably high application rate of 30 - 35 g/m² expressed as wet film.

Film transfer coaters have nevertheless limitations in terms of efficiency and economy. By virtue of a nip pressure, the nip of film transfer rolls provides a good penetration of size into the web's fiber structure, yet the nip has quite a short length, and therefore the actual absorption of size into the web does not take place until after the nip. Since, in practice, the size drying process must be started immediately after the nip for making the web dry to the touch and controllable, the total absorption time will be short. Although the film transfer press or coaters enable spreading quite a large amount of processing agent on the web, such large amounts of coating may result in a puddle between the web surface and the film transfer roll surface. The risk of creating a puddle is possibly increased by a high web speed, yet a puddle may develop even at a low speed. The creation of this, a so-called mini-puddle, limits a maximum application rate, since the puddle results in splashes, web vibration, and even passage of air through the nip because of its powerful swirling. In a film transfer nip, the web is severely wetted by large amounts of size, resulting in runnability problems. As a result of wetting, the web becomes weaker and hence more susceptible to tearing. In addition, wetting and drying change dimensions of the web and the dimensional changes must be accounted for by adjusting the web tension and possibly by using spreader rolls. The application chambers of film transfer coaters are quite precisely designed for ensuring a consistent spreading of the size. However, the surface of a fibrous web constantly releases material, which may find its way into the application chamber either directly on the surface of a film transfer roll or along with machine circulation. This causes trouble, especially when it ends up under the doctor rod, and even causes blocking in the application chamber. Furthermore, the application chamber-defining doctor rods and cradles holding the same wear down rapidly, resulting in short service intervals. This causes high maintenance costs and less production because of maintenance downtimes. These problems are accentuated in machines using recycled fiber, since among recycled fiber there are always abrasive foreign substances, a notable

one of which are particularly abrasive pigment coating particles traveling with the fiber. Since recycled fiber is an important raw material in board making, these problems are particularly pronounced in machines used in the production of packaging board. During application, the machine circulation of a coater is readily accessible to air and impurities, which must be removed with powerful air exhausters and screening devices. These devices are expensive and the necessary machine circulation will be long in distance and large in capacity.

10 The present Applicant's earlier patent publication FI121084 discloses a method of conducting surface sizing, which is based on spreading the surface size with a spray application unit, followed by guiding the web into a nip located between two rolls at a distance from the spreading point.

15 It is an objective of the present invention to provide an even further improved method and apparatus for surface sizing various fibrous webs more effectively than before, wherein the application can be preferably conducted as spray application or e.g. film transfer application. In addition to surface sizing, the invention is useful in the process of coating or pigmentation.

20 In order to achieve this objective, a method of the invention is characterized in that the method comprises using at the application stage a surface size having its dry matter content within the range of 20-30%, and that the application is conducted as a spray application process.

25 On the other hand, an apparatus of the invention is characterized in that the application elements comprise a spray application unit, which is adapted to apply a surface size having its dry matter content within the range of 20-30%.

30

The use of a surface size having its DMC preferably within the range of 20-30% makes it possible to reduce the length of or exclude a dryer section after sizing and to conduct the drying directly by means of a metal belt-equipped processing unit. In case of a separate drying stage, it can be
5 conducted e.g. with a fluid bed dryer or a cylinder dryer, or by means of slight drying/absorption taking place during the course of unsupported draw.

A benefit of the invention is a reduced-length dryer section downstream of the application with no absolute need for a separate drying unit, but, instead,
10 the web dries slightly or the surface size is absorbed into the web during the course of unsupported draw, and the web proceeds in a dry-to-the-touch condition to a metal belt circulation-equipped processing unit. The solution of the invention enables achieving an increase of speed for the line by replacing e.g. the cylinder dryers of a currently existing line with a metal belt
15 circulation-equipped processing unit. The speed increase is enabled by having a higher dry matter content, whereby the drying stage involves less water to be vaporized. In addition, such a metal belt circulation-equipped processing unit maintains the web's bulk level.

20 A multitude of various paper and board grades are in existence and can be divided into two classes according to basis weight: papers in single ply with a basis weight of 25-300 g/m² and boards manufactured in multi-ply technique or coming in single ply and having a basis weight of 100-600 g/m². As can be noted, the boundary between paper and board is flexible, with boards of the
25 lightest basis weight being lighter than the heaviest papers. As a general rule, paper is used for printing and board for packaging. Papers and boards can be coated or uncoated.

The following descriptions are examples of currently applied values for
30 fibrous webs and may exhibit considerable fluctuations from the given values. The descriptions are mainly based on the source publication

Papermaking Science and Technology, Papermaking part 3, Finishing, Edited by Jokio, M., published by Fapet Oy, Jyväskylä, 361 pages.

Printing papers made from mechanical pulp, i.e. containing wood, include
5 newsprint, coated magazine and uncoated magazine paper.

Newsprint consists either entirely of mechanical pulp or may have a low content of bleached softwood pulp (0-15%), and/or recycled fiber can be substituted for some of the mechanical pulp. General values for newsprint
10 can probably be regarded as follows: basis weight 40–48.8 g/m², ash content (SCAN-P 5:63) 0–20%, PPS s10 roughness (SCAN-P 76-95) 3.0–4.5 µm, Bendtsen roughness (SCAN-P21:67) 100–200 ml/min, density 600–750 kg/m³, brightness (ISO 2470:1999) 57–63%, and opacity (ISO 2470:1998) 90–96%.

15 Uncoated magazine paper (SC = supercalendered) generally contains mechanical pulp 50-70%, bleached softwood pulp 10-25%, and fillers 15-30%. Typical values for calendered SC paper (contains e.g. SC-C, SC-B and SC-A/A+) are basis weight 40–60 g/m², ash content (SCAN-P 5:63) 0–35%,
20 Hunter gloss (ISO/DIS 8254/1) < 20–50%, PPS s10 roughness (SCAN-P 76:95) 1.0–2.5 µm, density 700–1250 kg/m³, brightness (ISO 2470:1999) 62–70%, and opacity (ISO 2470:1998) 90–95%.

Coated magazine paper (LWC = light weight coated) contains mechanical
25 pulp 40-60%, bleached softwood pulp 25-40%, and filling and coating agents 20-35%. General values for LWC paper can be regarded as follows: basis weight 40–70 g/m², Hunter gloss (ISO 8254-1) 50–65%, PPS S10 roughness (SCAN-P 76/95) 0.8–1.5 µm (offset) and 0.6–1.0 µm (roto), density 1100–1250 kg/m³, brightness (ISO 2470) 70–75%, and opacity (ISO
30 2471) 89–94%.

General values for MFC paper (machine finished coated) can be regarded as follows: basis weight 50–70 g/m², Hunter gloss (ISO 8254-1) 25–70%, PPS S10 roughness (SCAN-P 76/95) 2.2–2.8 µm, density 900–950 kg/m³, brightness (ISO 2470) 70–75%, and opacity (ISO 2471) 91–95%.

5

General values for FCO paper (film coated offset) can be regarded as follows: basis weight 40–70 g/m², Hunter gloss (ISO 8254-1) 45–55%, PPS S10 roughness (SCAN-P 76/95) 1.5–2.0 µm, density 1000–1050 kg/m³, brightness (ISO 2470) 70–75%, and opacity (ISO 2471) 91–95%.

10

General values for MWC paper (medium weight coated) can be regarded as follows: basis weight 70–90 g/m², Hunter gloss (ISO 8254-1) 65–75%, PPS S10 roughness (SCAN-P 76/95) 0.6–1.0 µm, density 1150–1250 kg/m³, brightness (ISO 2470) 70–75%, and opacity (ISO 2471) 89–94%.

15

HWC (heavy weight coated) has a basis weight of 100–135 g/m² and it can be coated even more than twice.

20

Woodfree printing papers made from chemical pulp, i.e. fine grade papers, include uncoated - and coated printing papers, which are based on chemical pulp and in which the proportion of mechanical pulp is less than 10%.

25

Uncoated chemical pulp-based printing papers (WFU) have bleached birch pulp 55–80%, bleached softwood pulp 0–30%, and fillers 10–30%. In WFU, the values fluctuate over a wide range: basis weight 50–90 g/m² (up to 240 g/m²), Bendtsen roughness 250–400 ml/min, brightness 86–92%, and opacity 83–98%.

30

In coated woodfree printing papers based on chemical pulp, i.e. in fine grade papers, the coating amounts fluctuate over a wide range according to demands and intended use. The following are typical values for once- and

twice-coated chemical pulp-based printing paper: once-coated, basis weight 90 g/m², Hunter gloss (ISO 8254-1) 65–80%, PPS S10 roughness (SCAN-P 76/95) 0.75–2.2 µm, brightness (ISO 2470) 80–88%, and opacity (ISO 2471) 91–94%, and for twice-coated, basis weight 130 g/m², Hunter gloss (ISO 8254-1) 70–80%, PPS S10 roughness (SCAN-P 76/95) 0.65–0.95 µm, brightness (ISO 2470) 83–90% , and opacity (ISO 2471) 95–97%.

Heat sensitive papers have a heat-sensitive coating layer, which may contain e.g. heat sensitive wax separating a color-forming agent and a receiving reactive agent. Upon heating the surface of paper, the wax melts allowing said agents to make contact with each other, thus producing a desired image. The base paper generally comprises a paper, which has a basis weight within the range of 40–60 g/m² and which is usually pre-coated or surface-sized. In addition, the heat-sensitive coating layer can be protected by means of a protective coating layer.

Release papers have a basis weight fluctuation range of 25–150 g/m².

Other papers include ao. sackkraft, tissues, and wallpaper bases.

Boards make up quite a heterogeneous group, comprising high basis weight grades, possibly having a basis weight of as high as 600 g/m², and low basis weight grades with a basis weight of about 100 g/m², whereby the grades may range from those based on primary fiber to those based by up to 100% on recycled fiber, and from uncoated ones to those with multiple coatings.

Coated boards include as follows:

- FBB (= folding boxboard) based on primary fiber, SBS (= solid bleached board), LPB (= liquid packaging board), coated white top liner, carrier board

- WLC (= white lined chipboard) based on recycled fiber, coated recycled board.

5 The solution proposed in the invention is basically applicable for all the above-listed grades, while fine grade papers make up the principal application field.

The invention will now be described with reference to the accompanying figures, in which:

10

Fig. 1 shows one embodiment for an apparatus of the invention in a schematic view of principle, and

15

Fig. 2 shows another apparatus of the invention in a schematic view of principle.

20

The apparatus shown in fig 1 represents one preferred embodiment of the invention, wherein a surface sizing stage 1 is followed by conducting a web W by way of an air blower-deflector 2 to a processing unit 3, which is provided with a metal belt circulation and features a metal belt 10 adapted to circle around guide rolls 9. Outside the metal belt is disposed a backing roll 8, by way of which the metal belt runs, establishing between the same an extended nip PN for conducting the surface-sized web W therethrough.

25

The solution of fig. 2 differs from that of fig. 1 in the sense that in association with an application unit 1 is by means of nip rolls 4 provided a press nip N, wherefrom a web W is conducted by way of an air blower-deflector 2 to a group of drying cylinders 6 and from there further to a metal belt circulation-equipped processing unit 3. The solution of fig. 2 is longer than the one shown in fig. 1, but it can be conceivable for certain

30

applications and it also provides benefits over the prior art, such as speed increase and bulk improvement.

Claims

1. A method for surface sizing a fibrous web, said method comprising bringing a fibrous web to a surface sizing station, at which a surface size is applied to at least one side thereof; the application stage being followed by conducting the fibrous web, optionally by way of a surface sizing nip and/or optionally by way of a separate drying stage, to a metal belt-equipped processing unit, which includes a metal belt adapted to circle around at least one guide element, outside said metal belt being provided at least one backing element establishing a contact face with the metal belt, such that between the metal belt and the backing element is provided an extended web processing zone, the web to be processed being conducted therethrough, **characterized** in that the method comprises using at the application stage a surface size having its dry matter content within the range of 20-30%, and that the application is conducted as a spray application process.
2. A method as set forth in claim 1, **characterized** in that the spray application process is followed by conducting the web to a drying unit before passing it to the metal belt-equipped processing unit.
3. An apparatus for surface sizing a fibrous web, said apparatus comprising a surface sizing station provided with elements for applying a surface size to at least one surface of the fibrous web; and optionally elements, disposed after the surface sizing station and establishing a press nip, for pressing the surface-sized fibrous web and/or optionally separate drying elements; as well as a metal belt-equipped processing unit, which includes a metal belt adapted to circle around at least one guide element, outside said metal belt being provided at least one backing element establishing a contact face with the metal belt, such that between the metal belt and the backing element is provided an extended web processing zone, the web to be processed being

conductible therethrough, **characterized** in that the application elements comprise a spray application unit, which is adapted to apply a surface size having its dry matter content within the range of 20-30%.

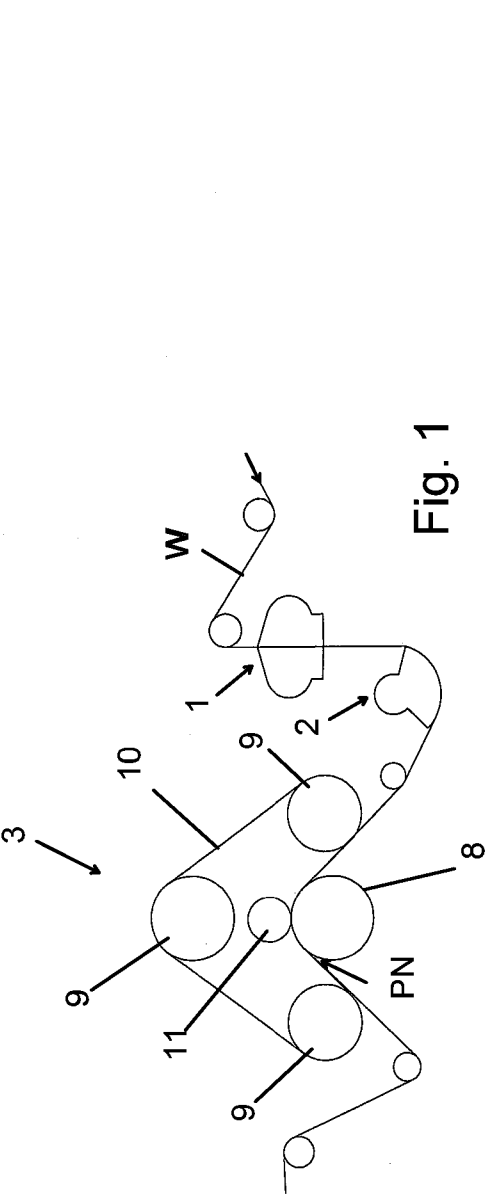


Fig. 1

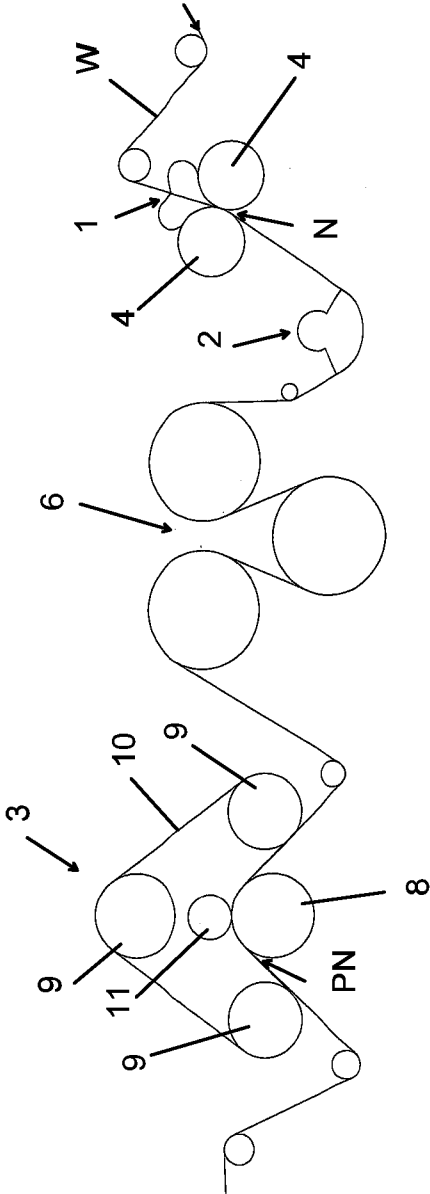


Fig. 2