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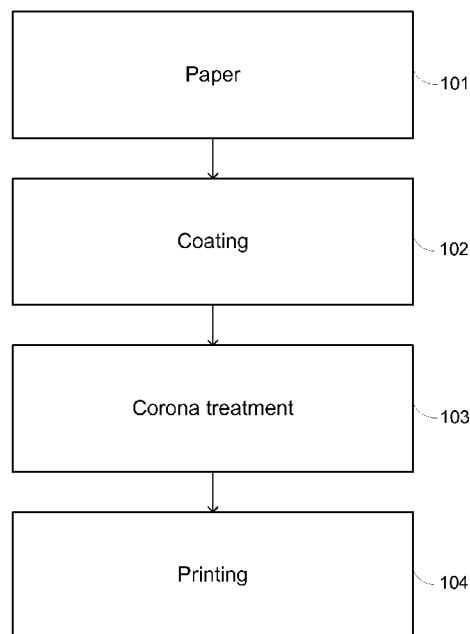


Fig. 1

(57) Abstract: The application relates to a paper suitable for printing. Further the application relates to providing paper for printing and receiving paper for printing, and apparatuses enabling providing a paper for printing, preparing a printable paper and printing the paper. According to an embodiment a method for providing a paper for printing comprises providing a coating on a surface of the paper, wherein the coating comprises at least 15 wt-% of binder. The coated paper is being sensitive to a corona treatment such that a surface energy of the coated paper being increaseable to at least 38 dynes/cm in response to the corona treatment. In an embodiment, a method comprises treating the coated paper with the corona treatment, and increasing a surface energy of the received coated paper to at least 38 dynes/cm in response to the corona treatment, before printing the paper.



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Paper for printing

Field of the Invention

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The application relates to a paper suitable for printing. Further the application relates to providing paper for printing and receiving paper for printing, and apparatuses enabling providing a paper for printing, preparing a printable paper and printing the paper.

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Background

A print on a paper usually has some desired qualities. Some print qualities are estimated visually, while some can be tested using certain parameters.

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Printing, requires certain characteristics from the paper. Paper characteristics, like basis weight, thickness, smoothness and ink absorbency, effect to its printability.

Summary

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The object of this application is to provide a paper for printing of satisfying printing quality. According to at least some embodiments paper is pre-treated so that satisfying printing quality is achieved with ultraviolet printing.

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According to an embodiment a paper for printing comprises a coating comprising at least 15 wt-% of binder. The coated paper is being sensitive to a corona treatment such that a surface energy of the paper is increasable to at least 38 dynes/cm in response the corona treatment.

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According to another embodiment a method for providing a paper for printing comprises a coating on a surface of the paper, wherein the coating comprises at least 15 wt-% of binder. The coated paper is being sensitive to a corona treatment such that a surface energy of the coated paper being increasable to at least 38 dynes/cm in response to the corona treatment.

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In an embodiment a method for receiving a paper for printing comprises the received paper comprising a coating, wherein the coating comprises at least

15wt-% of binder and the coating is being sensitive to a corona treatment. The received coated paper is treated with the corona treatment, and a surface energy of the received coated paper is increased to at least 38 dynes/cm in response to the corona treatment.

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In an embodiment an apparatus comprises paper machine in order to provide a paper and a coating module in order to provide a coating onto a surface of the paper. The coating comprises at least 15 wt-% of binder. The coated surface of the paper is being sensitive to a corona treatment such that a surface energy of the coated surface of the paper is increasable to at least 38 dynes/cm in response to a corona treatment.

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In an embodiment an apparatus for printing comprises a corona treatment module in order to treat a coated paper. The coating of the paper comprises at least 15 wt-% of binder. A surface energy of the coated paper is increased to at least 38 dynes/cm in response to the corona treatment. An embodiment may comprise a printing station for printing the coated, corona treated surface of the paper.

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According to an embodiment the paper is suitable for ultraviolet printing, or or ultraviolet inkjet printing.

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According to an embodiment, the paper comprises a label.

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Description of the Drawings

The following Figures illustrate some examples and embodiments of the present invention. The figures are illustrative examples, and in no way limiting the invention to a certain example.

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Figure 1 illustrates a method according to an embodiment of the invention.

Figure 2 illustrates an example of a coating apparatus according to an embodiment of the invention.

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- Figure 3 illustrates an example corona treatment apparatus according to an embodiment of the invention.
- 5 Figure 4 illustrates a side view an example corona treatment apparatus according to an embodiment of the invention.
- Figure 5 illustrates a printing apparatus according to an embodiment of the invention.
- 10 Figure 6 illustrates a label according to an embodiment of the invention.

Detailed Description of Embodiments

- 15 The following description describes some embodiments of the invention in further detail with the accompanying figures.

Figure 1 illustrates a method according to an embodiment of the invention. An embodiment of the invention relates to handling a base paper so that it is suitable for printing of desired quality. Base papers 101 have different properties. Properties or quality of a base paper have effect on printing quality. A quality of the base paper may be changed by providing a coating 102 on the base paper. Coating station may be located at the end phase of the paper machine. The coating layer comprises binder. Amount of the binder in the coating may be 10-30 wt-%. The coating 102 changes surface properties of the base paper. According to Figure 1, the surface of the paper becomes more closed or less porous due to the coating layer.

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A coating station may occur at the paper machine, i.e. on-line. In this case the base paper is directed to a coating phase. Alternatively, base paper may be coated off-line, at a separate phase and separate coating apparatus after the paper machine.

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Before printing 104, the coated paper is treated by a corona treatment 103. During the corona treatment an electric discharge is lead through a paper. The corona treatment effects surface properties of the paper, for example by changing surface tension of treated paper. After the corona treatment, the

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paper is directed to a printing press 104 for ultraviolet-light curable (UV) printing. UV printing quality may be enhanced or brought to a satisfying level by treating the paper according to an embodiment before printing.

- 5 In an embodiment, a base paper 101 is coated 102 in a coating module of a paper machine. A base paper 101 comprises a binder on its surface after the coating phase 102. The coated paper 102 is then transported to a separate adhesive station, where the coated paper 102 is made adhesive on one surface in order to form self-adhesive labels or stickers, for example. At an
10 adhesive station an adhesive is applied on a siliconized background of a release liner. The coated paper may be laminated onto the adhesive on a release liner. The coated paper overlaid to the release liner forms a self-adhesive layer structure. The structure may be called layer-, multilayer- or laminated structure. Next the layer structure may be transported to a printer
15 module, which may be off-line from the adhesive station. At the printer module, the coated surface of the layer structure is treated with a corona treatment 103. After the corona treatment, the surface energy of the treated surface is increased, and the surface is ready for printing. Next the coated surface of the layer structure is UV printed 104 at the printing module. After
20 printing, next phase may be cutting individual labels from a printed layer structure. In an embodiment, the phase comprises die cutting a continuous layer structure in order to form individual labels. The individual labels may still be attached to a continuous liner, or the labels may be separate individual labels after die-cut. In an embodiment, printing 104 is done on a reverse
25 (adhesive) side of a label. In this embodiment, an adhesive is provided to a printed side of the label after printing phase 104. Corona treatment 103 is done before printing. It is possible to provide printing on both sides of the label.
- 30 Papers have different properties and depending on the use, different requirements. One fundamental property of a paper is its basis weight, which is typically expressed as the weight in grams per square meter (g/m^2). Bulk indicates volume or thickness of a paper in relation to its weight. It is an inverse quantity of paper density (weight per unit volume). Decrease in bulk,
35 in other words increase in density, makes the a paper sheet smoother, glossier and less opaque. Bulk may be adjusted with calendering. Typically high bulk is desirable for absorbent papers, while lower bulk is preferred for

printing papers. Opacity is the measure of how much light is kept away from passing through a sheet of paper. The opacity of a paper is influenced by thickness, amount and kind of filler, degree of bleaching and coating, for example. Opacity may be measured as the percentage of light absorbed by a sheet of paper. Typically a paper has some percentage of moisture. Moisture, the amount of water present in a sheet of paper, is usually expressed as a percent. Moisture may be for example 2-12%. Moisture effects to physical properties of a paper. Water has effect of plasticizing the cellulose fiber and of relaxing and weakening the inter-fiber bonding. It also relates to static of paper sheet subjected to pressure and/or to friction. The tendency for paper to develop static becomes greater with increasing dryness. Smoothness relates to a surface contour of a paper. Generally it refers to flatness of the surface. Test conditions may consider roughness, smoothness and compressibility. Certain properties, like smoothness, texture and ink absorbency typically differ between the two sides of a paper.

A term base paper refers to a paper comprising natural fibres as its main raw material. Further, the base paper may comprise, for example, one or more fillers and/or additives. The base paper is preferably uncoated paper. The term natural fibre refers to any plant material that contains cellulose. The natural fibre may be wood-based. The wood may be softwood, such as spruce, pine, silver fir, larch, Douglas fir, or Canadian hemlock; or hardwood, such as birch, aspen, poplar, alder, eucalyptus, or acacia; or a mixture of softwood and hardwood. Other than wood-based raw materials may include agricultural waste, grasses or other plant materials, such as straw, leaves, bark, seeds, legumes, flowers, tops, or fruit, which have been obtained from cotton, corn, wheat, oat, rye, barley, rice, flax, hemp, Manila hemp, sisal hemp, jute, ramee, kenaf hemp, bagasse, bamboo, or reed. Preferably, the natural fibre comprises chemically pulped natural fibre, that is, pulp made in a chemical pulping process.

In an embodiment a base paper comprises raw material originating from a chemical pulp or a chemithermomechanical pulp (CTMP). The formed mass may be bleached. According to embodiments a content of fibres originated from a chemical pulp or a chemithermomechanical pulp comprises at least 50-60 percentage of weight (wt-%) of the base paper fibers. Advantageously the amount of chemical pulp and/or CTMP originated fibers of all the base

paper fibers is up to 80-90 wt-%. According to an embodiment most natural fibres, for example 95 wt-%, used in the base paper are chemically or chemithermomechanically pulped natural fibres. Alternatively or additionally, mass may originate at least partly from mechanical- or thermomechanical pulp. The diameter of the natural fibres is normally 15 to 25 μm and the length more than 500 μm , or for example 1-1.5 mm. However, the present invention is not intended to be limited to fiber size.

According to at least some embodiments a base paper comprises basis weight of 20-200 g/m^2 . A liner may comprise basis weight of 40-80 g/m^2 . According to another example liner comprising plastic may comprise basis weight of 15-50 g/m^2 . The base paper may comprise short and/or long fibres. Typically long fibres yield from softwood pulping, and short fibres from hardwood pulping. Long fibres of the softwood provide strength to a base paper and enhance runnability on a paper machine. Short fibres of the hardwood have effect on the end-use of the base paper, for example they enhance the printability of the paper.

According to at least some embodiments the base paper comprises a filler. The content of a filler in a base paper is 5-30 wt-%; advantageously 5-20 wt-%. The content of filler in a base paper depends on the utilization of the base paper. For example a base paper to be siliconized may comprise 0-15 wt-% filler; while a base paper used in a label product may comprise up to 15 wt-% filler. A filler may comprise clay. A filler is used to fill spaces between fibres in a base paper. A filler provides more weight to a base paper. In an end product an effect of a filler may be enhancing weight properties, smoothening a surface and/or decreasing opacity.

A base paper according to embodiments has such strength properties that it is suitable for coating according to embodiments. A base paper according to embodiments has such strength properties that it is suitable for finishing at a coating stage according to embodiments. The base paper withstands the amount of the used coating. The coated paper stands UV printing phase. The fibers of the base paper are oriented so that the base paper has required strength to both machine direction and the direction perpendicular to it. Depending on end use, even three dimensional strength properties may be required. For example packing material, which may be used for forming a

bag or a wrapper for a product, need to be strong in 3-dimensions. A packing material is required to withstand customer process of making a bag or a wrapper, and end use of filling and using the bag or the wrapper. In other example of label products strength of paper is required to withstand a die cutting phase, which comprises finalizing labels to obtain their final form by pressing with a metal frame and extracting extra portions at a process speed.

According to at least some embodiments of the present invention a surface of a base paper is coated. An embodiment of an example coating station is illustrated in Figure 2. Paper web 201 runs thru an application nip between the two rolls. Running directions are shown with thin arrows in the rolls and at the feeding side of the web. Coating paste 202 is applied to the paper web 201. Due to the external pressure in the application nip, the coating paste 202 penetrates to the paper 201. Extra coating 202 before and after the application nip is brought back to the paste tank. A coating knife 203 smoothens the coated surface and removes an extra coating from a coated paper 204. The coating according to embodiments may be implemented using other coating methods and apparatuses. For example, contour type coating, spray or curtain coating, or a film transfer coating. The coated paper 204 may be rolled in order to be stored. A roll of a coated paper 204 may be transported to a printing press or to a label station, for example. The coated paper 204 may be directed to a corona treatment station.

A coating comprises binders and pigments, and optionally additives. The coating may comprise an additive, like carboxymethyl cellulose, but typically amount is minor compared to the other ingredients. The pigments may be for example a calcium carbonate (CaCO_3) and clay. The coating may comprise amount of calcium carbonate in relation to the amount of clay 1:1. It is possible to employ more clay, or even only clay in a coating. Amount of clay in a coating may be 10-100 wt-%; or at least 10 wt-%; or preferably at least 15 wt-%; or more preferably at least 20 wt-%. In order to achieve light (-white), optical surface, a pigment may be added. Clay comprises plate like pigments, which provide a compact, tight surface. The coating has effect of providing good anchorage of printing ink and/or pigments of the printing ink to the surface.

The binder may comprise a corona sensitive material. A binder may comprise double bonds. The binder may be latex, for example a styrene butadiene latex (SB) or a styrene acrylic (SA). Amount of binder in the coating may be 10-30 wt-%. According to an embodiment, the amount of binder in the coating is 15-20 wt-%. According to at least one embodiment, the amount is 20-30 wt-%, or 20-25 wt-%, or 25-30 wt-%, or preferably 25 wt-%. Latex used as a binder enables coating on a paper machine. Latex has effect on later printing process. As an example, latex may have dominating effect for printability of the paper. Latex binds the pigments used in printing to the paper. The latex may provide a coating which is sensitive and/or reactive to a corona treatment. Coating of a paper enhances surface properties, for example smoothness, of the paper. One factor for printability is smoothness of the surface. Amount of roughness in the printable surface, worsens the printing result correspondingly.

Latex binds mineral pigments used in coating to each other and to the surface of the paper. The latex may have effect of providing a good base for printing. The latex may provide a compact and flexible structure. The latex may have effect of providing good bonding strength. For example if starch is used and the same bonding strength is desired, the amount of starch shall be two times the amount of latex. Thus less latex is enough for the same quality. Latex may provide a moisture resistant surface. A runnability is good with latex, when compared to a coating comprising starch, for example. The starch is a dry component, thus it requires lot of additional water during coating process. Amount of water in a starch leads to an end result, where the amount of starch in the coated paper is quite modest, for example 2-3 wt-% of the coated paper. Whereas amount of coating comprising latex may be for example 10 wt-% of the coated paper. Bigger amount of coating provides durability and strength to the coated paper.

The coating according to embodiments comprises binder(s) and pigment(s) 70-90 wt-%; preferably at least 70 wt-%; more preferably at least 80 wt-%; most preferably at least 90 wt-%. It is possible to utilize other pigment(s) instead of, or in combination with, carbonate. For example, titanium may be utilized.

The coating may be added on a surface of a paper at the end phase of the papermaking machine. It is also possible to add the coating layer off-line, during some later handling phase, after the papermaking machine. The coating process may be of a batch type or continuous. At least some
5 embodiment comprise a coating process, which is a continuous roll-to-roll process, wherein a continuous paper web is coated.

According to an embodiment the coating is applied on at least one surface of the paper in order to enhance the printing performance of the paper. The
10 coating may be added to one surface of the paper only. The other surface of the paper may comprise surface adhesive paste or starch, for example. A typical amount of reverse side adhesive paste or starch is $\frac{1}{2}$ -2 g/m². When the end product is a label, the other side may comprise an adhesive.

15 According to at least some embodiments the coating may comprise two or more coating layers. Sometimes better quality end results may be achieved, and/or properties of the coating increased, when at least two coatings are applied. It is possible to apply a pre-coating before applying the surface coating onto the paper. In one example, the content of a pre-coating
20 comprises 2-9 g/m²; preferably 4-6 g/m², and the content of a surface coating comprises 6-12 g/m². The coatings may comprise 22-24 parts binder, for example polyvinyl acetate (PVA). In at least some embodiments, the coating layers are similar layers, comprising the same components. Advantageously at least function of the separate coating layers is equal in an embodiment. In
25 alternative embodiment, a pre-coating may be different from the surface layer coating, which is described in detail in this application. In some embodiments the pre-coating and the surface coating together form a coating structure according to embodiments, as described in this application.

30 A coated paper according to an embodiment may comprise a basis weight of 30-205 g/m²; preferably 40-150 g/m². A paper for label use may comprise a basis weight of 45-100 g/m². A paper for packing use may comprise a basis weight of 40-140 g/m².

35 According to at least some embodiments, the coated paper is treated with corona. Figure 3 illustrates an apparatus for corona treatment according to an embodiment. Figure 4 illustrates similar apparatus as a side view. The

same reference numbers in Figures 3 and 4 refer to the same parts of the apparatus according to an embodiment. The Figures are not in scale. The apparatus of Figures 3 and 4 comprises a bottom roll 1105 and an electrode 1002. The bottom roll 1005 comprises an electrically grounded 1009 roll 1005. The bottom roll 1005 may be covered by a dielectric 1106, for example a polyester wrapping. The electrode 1002 may comprise straight or segmented metal bar matching to the width and length of the paper web 1107. Other forms are possible, like sets of segmented electrodes or rectangular ceramic tube filled with irregularly shaped aluminium alloy granules. Typical material of an electrode 1002 is metal or ceramic. A voltage is built up by a power supply 1101. The power supply may provide a standard frequency 50-60 Hz electrical power. The provided electrical power is converted to a single phase, higher frequency power, for example as a nominal power of frequency of 10-30 kHz, which is supplied to electrode 1002. The supplied power may be up to 10 kV. Thus the electrode 1102 gains a high potential, while the other electrode, being the roll 1105, is at the ground potential 1109. Potential difference between the electrodes 1102 and 1105 may be up to 80 kV at a frequency of 15-25 kHz. The bottom roll 1005 supports the paper web 1107 to be treated. One surface of the paper 1107 is facing high potential electrode 1102.

The built up voltage between the electrode 1102 and the roll 1105 induces high voltage discharge in the air gap 1108. Distance between the electrode 1102 and the roll 1105, i.e. the air gap 1108, may be for example 1.5-6.5 mm, depending on thickness of the material 1107 passing thru. Free electrons in the air gap 1108 are accelerated due to the induced high voltage discharge. The air gap 1108 is ionized. Due to strong electric discharge collisions of high velocity electrons with molecules of gas result in no loss of momentum, and electron avalanching occurs. The electrons created in discharge impact surface of a paper web 1107 in a discharge path. The electrons have energies strong enough to break molecular bonds on the surface of the paper 1107. This creates very reactive free radicals. Free radicals in the presence of oxygen can react rapidly in order to form various chemical functional groups on the paper surface. Surface treatment with high voltage modifies surface characteristics without affecting bulk properties of the paper.

Corona treatment raises surface energy of the treated paper. Surface energy is often measured in dynes per centimetre. Corresponding SI-unit is Newton such that $1 \text{ dyne} = 10^{-5} \text{ N}$. Surface energy has been measured according to standard ASTM D-5725 / TAPPI T-558. According to at least some
5 embodiments, a surface tension of at least 38 dynes/cm; or preferably at least 40 dynes/cm is achieved. Corona according to embodiments may be 120-200 W/min/m²; preferably 200 W/min/m²; more preferably 180 W/min/m²; most preferably 160 W/min/m². These are examples of corona, and also
10 other values may be utilized in order to achieve the surface tension according to an embodiment. Surface tension is transitory variable, thus it tends to degrade over time. An increased surface tension of a paper according to
15 embodiments has effect of providing better adhesion of inks, coatings and adhesives. The corona treated paper may have effect of improved printing quality, and stronger ink adhesion. A surface tension may have effect on
15 avoiding ink penetration to the coating and/or surface wetting.

Power of the corona treatment has effect on surface energy of the coated paper. Total surface energy comprises a dispersive component and a polar component. According to an embodiment a dispersive component of a
20 surface energy raises at least 15 %, when treated with corona. Change of the dispersive component of the surface energy is measured so that a value before the corona treatment is compared with a value after the corona treatment. According to embodiments the dispersive component of surface
25 energy raises at least 20 %; or preferably at least 25 %, when treated with corona. The corona according to embodiments may be of 120-200 W/min/m²; preferably 200 W/min/m²; more preferably 180 W/min/m²; most preferably 160 W/min/m². Other values for corona are possible in order to achieve the
30 dispersive component of the surface energy according to embodiments. The dispersive component of surface energy is measured as mJ/m², according to ASTM D-5725 / TAPPI T-558. The increase of the dispersive component of
35 the surface energy in response to corona treatment may have effect on improved printing quality. UV inks are non-polar, thus the UV ink may provide good spreading onto the corona treated surface. This has positive effect on
35 printing quality.

UV printing requires a closed printing surface in order to get a satisfying printing result. Coating and corona treatment according to all or at least some

embodiments have effect of providing a compact, tight surface. Roughness and porosity effect to qualities of the surface, e.g. tightness and closeness of the surface. Roughness of the surface is measured according to standard PPS10, ISO 8791. Roughness of the corona treated surface according to at least some embodiments of the invention is less than 2.5 μm ; preferably less than 2 μm ; more preferably less than 1.5 μm ; most preferably less than 1.3 μm . According to an embodiment, roughness of the surface is 1-1.2 μm . The minimum value for roughness may be 0.7 μm ; or preferably 0.6 μm ; or most preferably 0.2 μm .

Porosity of the coated and corona treated surface according to at least some embodiments is measured in accordance with Standard Oil Absorbency, Cobb Unger method, SCAN-P 37:77. The used absorption times are 3 seconds (CU_6), 5 seconds (CU_{10}) and 60 seconds (CU_{120}). Standard includes CU_6 , CU_{10} and CU_{30} . The longest measure was also done according to the standard method. According to at least some embodiments porosity values are less than 1.3 g/m^2 ; preferably less than 1.0 g/m^2 ; more preferably less than 0.6 g/m^2 , (or gsm, grams per square meter). Time used for the measurements is 5 seconds according to CU_{10} . The measurement contains some instability. Generally the oil absorption shall be as small as possible. In practise, currently value 0.1 may be seen as a low limit due to accuracy of the measurement.

At least some embodiments provide effect of surface wetting. At least most embodiments provide a surface, where ink penetration to the coating is modest, if any.

Alternative way of effecting a surface energy of a paper is utilizing a hydrophobic coating. The coating may comprise chemicals adjusting the hydrophobicity of the coated paper. Hydrophobic coating comprises less water than other kind of coatings. Hydrophobic paper is impermeable to water, thus absorption of water to the paper is prevented or delayed. This may have positive effect on paper strength and/or production phases. Hydrophobic chemicals may have effect on surface density of the coated paper due to surface chemistry and charging. Hydrophobic coating may be utilized with waterless printing inks. Hydrophobic paper may provide good ink- and waterproofness and printability.

UV printing is growing technology, especially for label stock printing. UV printing may comprise UV inkjet printing or UV flexo printing. Flexographic printing is a mechanical letterpress method implemented with a soft and flexible printing plate. At the printing stage, the material to be printed is conveyed between the flexible printing plate and a hard backing roll, wherein printing ink is transferred by pressing to a desired location in the material to be printed. In multicolour flexo printing, the ink layer needs to be dried (cured) after every printing unit. In multicolour UV inkjet printing inks may be dried simultaneously at one phase. UV curable inks may be used.

Figure 5 illustrates an example apparatus for UV inkjet printing according to an embodiment. UV inkjet apparatus may be called a printing apparatus, a printing press, or a printing station, for example. Apparatus of Figure 5 comprises an inkjet printing module 502, an UV light curing module 503. The inkjet printing module 502 comprises inkjet printing heads. The printing heads may be transversely or longitudinally moveable across the paper web 501. I.e. the printing heads may move to the machine direction or perpendicular to it, for example. Alternatively, the printing heads may be extended across the web in order to print the entire transverse line of points simultaneously onto the web 501. The UV light curing module 503 comprises beam of UV light, which is focused onto the printed surface of the web 501. The UV light beam may be synchronized with the moving printing heads of the inkjet printing module 502. The printing apparatus may comprise other modules. For example, a panel cutting module 504 for cutting separate labels from a label web after printing. The inkjet printing module 502 and the UV light curing module 503 are controlled, monitored and instructed by a control unit 505. The controlling unit may comprise a controller, or a microprocessor for executing instructions and a memory for storing the instructions. The panel cutting module 504 of Figure 5 is also controlled with the control unit 505.

UV curable printing inks are printing inks whose curing is not based on evaporation of a solvent substance as in conventional printing inks but on a polymerization reaction by means of UV radiation and oxygen. Typical UV radiation has wavelength of 180 to 380 nm. Dynamic viscosity of inks for flexographic printing may be, for example 0.05 to 0.5 Pascal seconds. The printing inks in mechanical printing may comprise pigment, binder and

solvent. UV printing ink may comprise 15-25 wt-% of pigment. In UV printing inks, the binder may comprise hydrocarbon resins and derivatives, polyamide, nitrocellulose, acrylic or styrene based polymers, or oligomers. The oligomers may be epoxy, polyester, urethane or acrylate based, for example. In addition the inks may comprise 25-35 wt-% of binder. Even if there are no actual solvents, functional monomers can be regarded as such in UV printing inks. The content of solvent may be, for example 10-30 wt-%. UV printing ink comprises an additive. The additive is a photoinitiator, which enables the polymerization reaction. The content of additives, such as photoinitiators, in UV ink may be 1-10 wt-%. Photoinitiators are compounds which contain reactive groups and react to high-energy radiation by starting the polymerization reaction. The energy of UV radiation as such is not sufficient for starting the polymerization reaction, but a radiation sensitive photoinitiator is also needed. Some typical photoinitiators which form free radicals comprise benzophenols, acetophenols, tertiary or acrylic amines, or their derivatives. For example, 2-isopropylthioxanthone (ITX) may be used as a photoinitiator. When exposed to the energy of UV radiation, the photoinitiators of the printing ink react by producing free radicals. The photoinitiator may start the curing reaction either by breaking into free radicals or ions. As a result of the reaction, the monomers and oligomers in the printing ink are combined and cross-linked to each other, forming polymer chains and simultaneously curing the printing ink to a solid base. This reaction is typically very fast, taking no longer than few seconds, or often hundredth parts of seconds.

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Use of UV curable printing inks lack evaporable solvents. Lacking solvents makes it possible to reduce effluents compared with solvent-based printing inks. UV curable inks may provide positive effects on curing rate, formability, resistance to chemicals and scratching, and colour saturation. Although UV inks currently cost more (per kilo) than water based inks, the UV inks provide a better ink coverage and less waste than water based inks. Thus UV inks provide effect of needing less waste handling and disposal than water based inks. In some cases the printing process may be slower for UV prints depending on the quality of ink used, but the UV prints provide the effect of improved print definition. Running and maintenance costs are currently higher, but due to the lack of volatile organic components (VOC's), also print quality is high. Further the lack of VOC's provide the effect of providing

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environmentally friendly, ecologically acceptable process. Because UV inks are near solid, dot gain is minimized resulting in a more accurate tonal balance. With UV printing inks, the thickness of the printing ink layer is typically 0.8 to 5.0 μm , while it is about 0.8 to 1 μm for solvent-based inks.

5 Because no mass is evaporated from UV inks after printing, it is easier to adjust the layer thickness. Since only minimum or no evaporation occurs, the inks are not spread, which positively effects the print quality. Compared with conventional printing inks, radiation curable printing inks have very high curing rate. The printing surfaces of UV inks are strong and glossy, which

10 make them usable for an end use, which is susceptible to wear, such as labels. Some working materials are available for UV printing, but for example papers for UV printing are currently much more expensive than normal paper used for example for label faces.

15 UV inks comprise oil-based solvents. In order to provide a good and/or satisfying printing quality, the ink shall cover the print area properly. On the other hand, the ink shall not penetrate too deep onto the paper. The ink may penetrate to deepness of 5-10 microns from the paper surface. If the ink penetrates deeper than 10 microns to the paper, the UV light is not able to

20 cure the ink. The UV curable ink on the surface of the paper shall be cured with the UV light.

Figure 6 illustrates a label according to an embodiment. A label 3 refers to a piece of material, which is attachable to an article. Typically a label is

25 attached to an article in order to provide a visual effect, identify and/or publish information on article. A label 3 comprises a facestock layer 6 and an adhesive layer 16 for attaching the facestock to an article. A printed label 3 comprises a top layer, which is the facestock layer 6 and a printing layer 8. The printing layer 8 may be on the top or on the reverse side of the facestock

30 6. The printing layer 8 may be overlaminated or varnished in order to provide an additional protective layer on it. No additional protective layer is needed, if the reverse side of the facestock 6 is printed. The label facestock 6 may comprise a printed paper according to at least some embodiments. The printed label 3 may be non-adhesive, such as a shrink sleeve or in-mould

35 label, or it may comprise an adhesive layer in order to form a printed adhesive label. The label can be attached with an adhesive layer. The adhesive layer may comprise a heat activated adhesive, a wet glue adhesive

or a pressure sensitive adhesive. The adhesive may be activated with certain temperature, pressure or both. Label may be attached during manufacturing of an item, as in-mould.

5 Label structure may comprise a release liner 10 comprising backing material coated with a layer of a release agent, such as silicone, so as to form a printed label laminate 12. The backing material may be plastic film or paper based. The plastic film may be, for example, a polyester film, a biaxially or machine-direction oriented polypropylene film. The thickness of the plastic
10 liner is preferably 20-30 microns, or even less than 20 microns. Paper liners may have a thickness of 40-60 microns. The individual labels 3 may be cut from the label laminate structure. The individual labels may be completely separate, where the liner is cut with the individual labels. The release liner protects the adhesive and is removed prior to the application of the label onto
15 a surface of an item. Also linerless labels or non-adhesive labels, such shrink sleeves or in-mould labels, may be provided in a continuous label web, which may be further cut to form individual labels. The label may be used for labelling of items, such as plastic or paper packages, bottles, or other containers.

20 Generally, labels need to be produced as effectively as possible without compromising their workability and usability. A label materials have strength requirements, for example during label formation, where individual labels are cut off from a label web at a process speed.

25 In an example embodiment, a base paper comprises a basis weight of 50 g/m². Amount of a filler in the base paper is at least 20 wt-%. The base paper comprises at least 60 wt-% of fibres originated from pure chemical pulping. The base paper is coated on one side with a coating paste comprising at
30 least 80 wt-% of mixture of latex, clay and carbonate. Amount of coating is 15 g/m². The paper may be pre-coated so that combination of the coating layers provide the mentioned coating. The coating is sensitive to a corona treatment. The coated paper is treated with corona using 1.0 kW. After the corona treatment, the paper is printed using UV inkjet. The UV ink is spread
35 on the surface of the coated paper and cured with UV light.

In another example embodiment, a base paper comprises basis weight of 140 g/m². The base paper comprises at least 80 wt-% of fibres originated from pure chemical pulping and/or chemithermomechanical pulping. The base paper is coated on one side with a coating paste comprising at least 90 wt-% of mixture of latex, clay and carbonate. Amount of coating is 20-30 g/m². The coated paper is treated with a corona of 0.8 kW. After corona treatment, the paper is printed with UV inkjet printing.

Combustion residues of a paper coated, treated and printed according to embodiments may be analysed. Combustion residues comprise certain amount of ash. The residual ash originates from base paper, coating paste and printing ink. The total ash analysed from a printed paper according to an embodiment is 15-40 %; or 20-35 %; or at least 20%.

Good or sufficient printing quality may be measured using certain variables. Printing quality is a visible characteristic, and it may be evaluated visually. For example, amount and quality of droplets, stripes and pinholes may be evaluated visually. The printing ink is in liquid form in order to get well mixed. The liquid printing ink shall preferably extend somewhat after hitting a printable surface, but the droplets of the printing ink should not join together. Joining of droplets may be problematic, if the droplets instead of slightly penetrating to the surface, tend to move on the surface. Due to movements droplets join together forming bigger droplets, whereby the printing result lacks details. Stripes are due to wetting issue. If too much moisture is present, droplets have more time to join. Joined droplets further form pinholes. For example two neighbouring droplets joining together will form small area around them lacking printing ink. The satisfying printing quality may be dependent on the end use and product. However, certain characteristics, like the previously mentioned, may be used to evaluate the printing quality. There are other ways and features that can be used for evaluating the printing quality.

Treating the coated paper according to at least some of the embodiments has effect of providing a good printing quality. The surface suitable for printing shall have a sufficiently high surface tension. At least some embodiments may provide an effect of maintaining the surface tension level

higher than or equal to 40 dynes. At least some embodiments may provide an effect of good immediate adhesion of the printing ink.

- 5 At least some of the embodiments have effect of increasing the dispersive component of the surface energy of the coated, corona treated paper. This has effect of providing good base for printing, and/or a good quality printing. The coating and corona treatment provide an effect of good spreading of non-polar printing inks. This in turn has positive effect on printing quality.
- 10 At least some embodiments have effect of providing smooth paper for printing. Smoothness of the paper is due to the pre-treatment of a bas paper according to embodiments. Smoothness of the printable surface enables printing result including details. This has positive effect on printing quality.
- 15 At least some embodiments have effect of providing a good coverage of the printing ink to a printed surface. The printing ink shall not penetrate deep, e.g over 10 microns, in the surface, where the UV light is not able to cure the ink. The printing ink penetrates only slightly, for example 5-10 microns, in order to being curable with UV light. Smoothness of the surface and/or porosity of the
- 20 surface has effect on printing ink coverage and penetration. Smoothness and/or porosity are effected by the coating according to embodiments.

Claims:

1. A paper for printing comprising a coating comprising at least 15 wt-% of binder, wherein the coated paper being sensitive to a corona treatment such
5 that a surface energy of the coated paper is increasable to at least 38 dynes/cm in response the corona treatment.
2. A paper for printing according to claim 1, wherein the coating comprises 15-30 wt-% of binder; or preferably 20-30 wt-% of binder; or more preferably
10 20-25 wt-% of binder; or most preferably 25-30 wt-% of binder.
3. A paper for printing according to claims 1 or 2, wherein the binder comprises at least one of double bonds and latex.
- 15 4. A paper for printing according to any of claims 1-3, wherein the coating comprises content of binder(s) and pigment(s) of 70-90 wt-%; or preferably at least 70 wt-%; or more preferably at least 80 wt-%; or most preferably at least 90 wt-%.
- 20 5. A paper for printing according to any of claims 1-4, wherein the binder comprises a corona sensitive binder.
6. A paper for printing according to any of claims 1-5, wherein the paper comprises fibres originated from at least one of chemical pulp and
25 chemithermomechanical pulp (CTMP).
7. A paper for printing according to any of claims 1-6, wherein the paper comprises fibres, wherein 50-60 wt-% of the fibres; or preferably 80-90 wt-% of the fibres are originated from at least one of a chemical pulp and
30 chemithermomechanical pulp (CTMP).
8. A paper for printing according to any of claims 1-7, wherein the coated paper comprises basis weight of 30-205 g/m²; or preferably 40-150 g/m².
- 35 9. A paper for printing according to any of claims 1-8, wherein the coated paper comprises content of coating of 5-20 g/m²; preferably 10-15 g/m².

10. A paper for printing according to any of claims 1-9, wherein the coated surface of the paper comprises porosity of at less than 1.3 gsm; or preferably less than 1 gsm; or more preferably less than 0.6 gsm, measured in accordance with Standard Oil Absorbency, Cobb Unger method, SCAN-P 37:77.
11. A paper for printing according to any of claims 1-10, wherein the coated surface of the paper comprises surface roughness of less than 2.5 μm ; or preferably less than 2 μm ; or more preferably less than 1.5 μm , measured according to standard PPS10, ISO 8791.
12. A paper for printing according to any of claims 1-11, wherein the coated paper is sensitive to the corona treatment such that the surface energy of the coated paper is increasable to at least 40 dynes/cm in response the corona treatment.
13. A paper for printing according to any of claims 1-12, wherein the coated paper is reactive to the corona treatment such that a dispersive component of the surface energy of the coated paper increases.
14. A paper for printing according to any of claims 1-12, wherein the coated paper is reactive to the corona treatment such that a dispersive component of the surface energy of the coated paper increases at least 15 %; preferably at least 20 %; or more preferably at least 25 %, when treated with corona.
15. A paper for printing according to any of claims 1-14, wherein the coated paper is reactive to the corona treatment of 120-200 W/min/m².
16. A paper for printing according to any of claims 1-14, wherein the coated paper is reactive to the corona treatment of 200 W/min/m²; preferably 180 W/min/m²; most preferably 160 W/min/m².
17. A paper for printing according to any of claims 1-16, wherein the paper comprises paper for UV-light curable printing, or UV inkjet printing.
18. A paper for printing according to any of claims 1-17, wherein the coated paper comprises UV cured print on the coated and corona treated surface.

19. A paper for printing according any of claims 1-18, wherein the coated paper comprises the coated surface and an opposing surface comprising an adhesive, wherein the opposing surface optionally further comprises a release liner.
20. A method for providing a paper for printing comprising providing a coating on a surface of the paper, wherein the coating comprises at least 15 wt-% of binder, and wherein the coated paper is being sensitive to a corona treatment such that a surface energy of the coated paper being increasable to at least 38 dynes/cm in response to the corona treatment.
21. A method for providing a paper for printing according to claim 20 comprising providing a coating at a coating station.
22. A method for providing a paper for printing according to any of claims 20-21 comprising providing a coating at an on-line coating station of a paper machine.
23. A method for providing a paper for printing according to any of claims 20-22 comprising providing a coating at an off-line coating station.
24. A method for providing a paper for printing according to any of claims 20-23 comprising an off-line corona treatment module for providing a corona treatment.
25. A method for providing a paper for printing according to any of claims 20-24 comprising a corona treatment module at a printing apparatus.
26. A method for providing a paper for printing according to any of claims 20-25, wherein the providing a coating comprises providing a coating comprising 15-30 wt-% of binder; or preferably 20-30 wt-% of binder; or more preferably 20-25 wt-% of binder; or most preferably 25-30 wt-% of binder.
27. A method for providing a paper for printing according to any of claims 20-26, wherein the binder comprises at least one of double bonds and latex.

28. A method for providing a paper for printing according to any of claims 20-27, wherein providing a coating comprises providing a coating comprising content of binder(s) and pigment(s) of 70-90 wt-%; or preferably at least 70 wt-%; or more preferably at least 80 wt-%; or most preferably at least 90 wt-%.
29. A method for providing a paper for printing according to any of claims 20-28, wherein the binder comprises a corona sensitive binder.
30. A method for providing a paper for printing according to any of claims 20-29, wherein the paper comprises fibres originated from at least one of a chemical pulp and chemithermomechanical pulp (CTMP).
31. A method for providing a paper for printing according to any of claims 20-30, wherein the paper comprises fibres, wherein 50-60 wt-% of the fibres; or preferably 80-90 wt-% of the fibres are originated from at least one of a chemicalpulp and chemithermomechanical pulp (CTMP).
32. A method for providing a paper for printing according to any of claims 20-31, wherein the coated paper comprises basis weight of 30-205 g/m²; or preferably 40-150 g/m².
33. A method for providing a paper for printing according to any of claims 20-32, wherein the coated paper comprises content of coating of 5-20 g/m²; preferably 10-15 g/m².
34. A method for providing a paper for printing according to any of claims 20-33, wherein the coated surface of the paper comprises porosity of at less than 1.3 gsm; or preferably less than 1 gsm,; or more preferably less than 0.6 gsm, measured in accordance with Standard Oil Absorbency, Cobb Unger method, SCAN-P 37:77.
35. A method for providing a paper for printing according any of claims 20-34, wherein the coated surface of the paper comprises surface roughness of less than 2.5 µm; or preferably less than 2 µm; or more preferably less than 1.5 µm, measured according to standard PPS10, ISO 8791.

36. A method for providing a paper for printing according to any of claims 20-35, wherein the coated paper is reactive to the corona treatment such that the surface energy of the paper is increasable to at least 40 dynes/cm in response to the corona treatment.
- 5 37. A method for providing a paper for printing according to any of claims 20-36, wherein the coated paper is reactive to the corona treatment such that a dispersive component of the surface energy of the coated paper increases.
- 10 38. A method for providing a paper for printing according to any of claims 20-36, wherein the coated paper is reactive to the corona treatment such that a dispersive component of the surface energy of the coated paper increases at least 15 %; preferably at least 20 %; or more preferably at least 25 %, when treated with corona.
- 15 39. A method for providing a paper for printing according to any of claims 20-38, wherein the coated paper is reactive to the corona treatment of 120-200 W/min/m².
- 20 40. A paper for providing a paper for printing according to any of claims 20-38, wherein the coated paper is reactive to the corona treatment of 200 W/min/m²; preferably 180 W/min/m²; most preferably 160 W/min/m².
- 25 41. A method for providing a paper for printing according to any of claims 20-40, wherein the paper comprises at least one of paper for UV-light curable printing; or paper for UV inkjet printing.
- 30 42. A method for providing a paper for printing according any of claims 20-41, comprising applying an adhesive on a surface opposite to the coated surface of the paper.
- 35 43. A method for providing a paper for printing according to any of claims 1-19, comprising printing the coated and corona treated surface of the paper with an UV printing apparatus.
44. A method for receiving a paper for printing, wherein the received paper comprises a coating comprising at least 15wt-% of binder, and wherein the

coating is being sensitive to a corona treatment; treating the received coated paper with the corona treatment, and increasing a surface energy of the received coated paper to at least 38 dynes/cm in response to the corona treatment.

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45. A method for providing a paper for printing according to claim 44 comprising a corona treatment module.

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46. A method for providing a paper for printing according to any of claims 44-45 comprising a corona treatment module at a printing apparatus.

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47. A method for receiving a paper for printing according to any of claims 44-46, wherein the coating comprises 15-30 wt-% of binder; or preferably 20-30 wt-% of binder; or more preferably 20-25 wt-% of binder; or most preferably 25-30 wt-% of binder.

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48. A method for receiving paper for printing according to any of claims 44-47, wherein the binder comprises at least one of double bonds and latex.

49. A method for receiving paper for printing according to any of claims 44-48, wherein the coating comprises content of binder(s) and pigment(s) of 70-90 wt-%; or preferably at least 70 wt-%; or more preferably at least 80 wt-%; or most preferably at least 90 wt-%.

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50. A method for receiving paper for printing according to any of claims 44-49, wherein the binder comprises a corona sensitive binder.

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51. A method for receiving paper for printing according to any of claims 44-50, wherein the paper comprises fibres originated from at least one of a chemical pulp and chemithermomechanical pulp (CTMP).

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52. A method for receiving paper for printing according to any of claims 44-51, wherein the paper comprises fibres, wherein 50-60 wt-% of the fibres; or preferably 80-90 wt-% of the fibres are originated from at least one of a chemical pulp and chemithermomechanical pulp (CTMP).

53. A method for receiving paper for printing according to any of claims 44-52, wherein the coated paper comprises basis weight of 30-205 g/m²; or preferably 40-150 g/m².
- 5 54. A method for receiving paper for printing according to any of claims 44-53, wherein the coated paper comprises content of coating of 5-20 g/m²; preferably 10-15 g/m².
- 10 55. A method for receiving a paper for printing according to any of claims 44-54, wherein the coated surface of the paper comprises porosity of at less than 1.3 gsm; or preferably less than 1 gsm; or more preferably less than 0.6 gsm, measured in accordance with Standard Oil Absorbency, Cobb Unger method, SCAN-P 37:77.
- 15 56. A method for receiving a paper for printing according any of claims 44-55, wherein the coated surface of the paper comprises surface roughness of less than 2.5 µm; or preferably less than 2 µm; or more preferably less than 1.5 µm, measured according to standard PPS10, ISO 8791.
- 20 57. A method for receiving a paper for printing according to any of claims 44-56, wherein treating the received coated paper with the corona treatment, and increasing a surface energy of the received coated paper comprises increasing a surface energy of the received coated paper to at least 40 dynes/cm in response to the corona treatment.
- 25 58. A method for receiving a paper for printing according to any of claims 44-57, wherein treating the received coated paper with the corona treatment, and increasing a surface energy of the received coated paper comprises increasing a dispersive component of the surface energy of the coated paper.
- 30 59. A method for receiving a paper for printing according to any of claims 44-57, wherein treating the received coated paper with the corona treatment, and increasing a surface energy of the received coated paper comprises increasing a dispersive component of the surface energy of the coated paper
- 35 at least 15 %; preferably at least 20 %; or more preferably at least 25 %, when treated with corona.

60. A paper for printing according to any of claims 44-59, wherein the coated paper is reactive to the corona treatment of 120-200 W/min/m².
- 5 61. A paper for printing according to any of claims 44-59, wherein the coated paper is reactive to the corona treatment of 200 W/min/m²; preferably 180 W/min/m²; most preferably 160 W/min/m².
- 10 62. A method for receiving a paper for printing according to any of claims 44-61, further comprising printing the corona treated paper with at least one of UV-light curable printing and UV inkjet printing.
- 15 63. A method for receiving a paper for printing according to any of claims 44-62, comprising an UV printing apparatus, optionally an UV inkjet printing apparatus.
64. A method for receiving a paper for printing according any of claims 44-63, wherein receiving the coated paper comprises receiving the coated paper comprising adhesive on a surface opposite to the coated surface.
- 20 65. An apparatus for providing a paper for printing comprising means for providing a paper according to any of claims 1-19.
- 25 66. An apparatus according to claim 65 comprising a paper machine for providing the paper, and a coating station for coating the paper.
67. An apparatus according to claim 65 or 66 comprising a coating station in-line with the paper machine.
- 30 68. An apparatus for receiving a paper for printing comprising means for receiving a paper according to any of claims 1-19.
- 35 69. An apparatus according to claim 68 comprising a corona treatment module for treating the coated paper with the corona treatment, and an UV printing apparatus for printing the paper.
70. An apparatus according to claim 69 comprising a corona treatment module before an UV printing apparatus.

71. An apparatus according to claim 69 or 70 comprising the corona treatment module in-line with the UV printing apparatus.
- 5 72. An apparatus according to any of claims 68-71 comprising an UV inkjet printing apparatus for printing the paper.
73. An apparatus comprising paper machine in order to provide a paper and a coating station in order to provide a coating onto a surface of the paper, wherein the coating comprises at least 15 wt-% of binder, and wherein the coated surface of the paper being sensitive to a corona treatment such that a surface energy of the coated surface of the paper is increasable to at least 38 dynes/cm in response to the corona treatment.
- 10
74. An apparatus according to claim 73, wherein the corona treatment comprises corona treatment of 120-200 W/min/m².
- 15
75. An apparatus according to claim 73, wherein the corona treatment comprises corona treatment of 200 W/min/m²; preferably 180 W/min/m²; most preferably 160 W/min/m².
- 20
76. An apparatus according to claim 73 comprising a coating station in-line with the paper machine.
77. An apparatus according to claim 73 comprising a corona treatment module off-line from the paper machine.
- 25
78. An apparatus comprising a corona treatment module in order to treat a coated paper, wherein a coating comprises at least 15 wt-% of binder, and wherein a surface energy of the coated paper is increased to at least 38 dynes/cm in response to the corona treatment.
- 30
79. An apparatus according to claim 78, wherein the corona treatment comprises corona treatment of 120-200 W/min/m².
- 35

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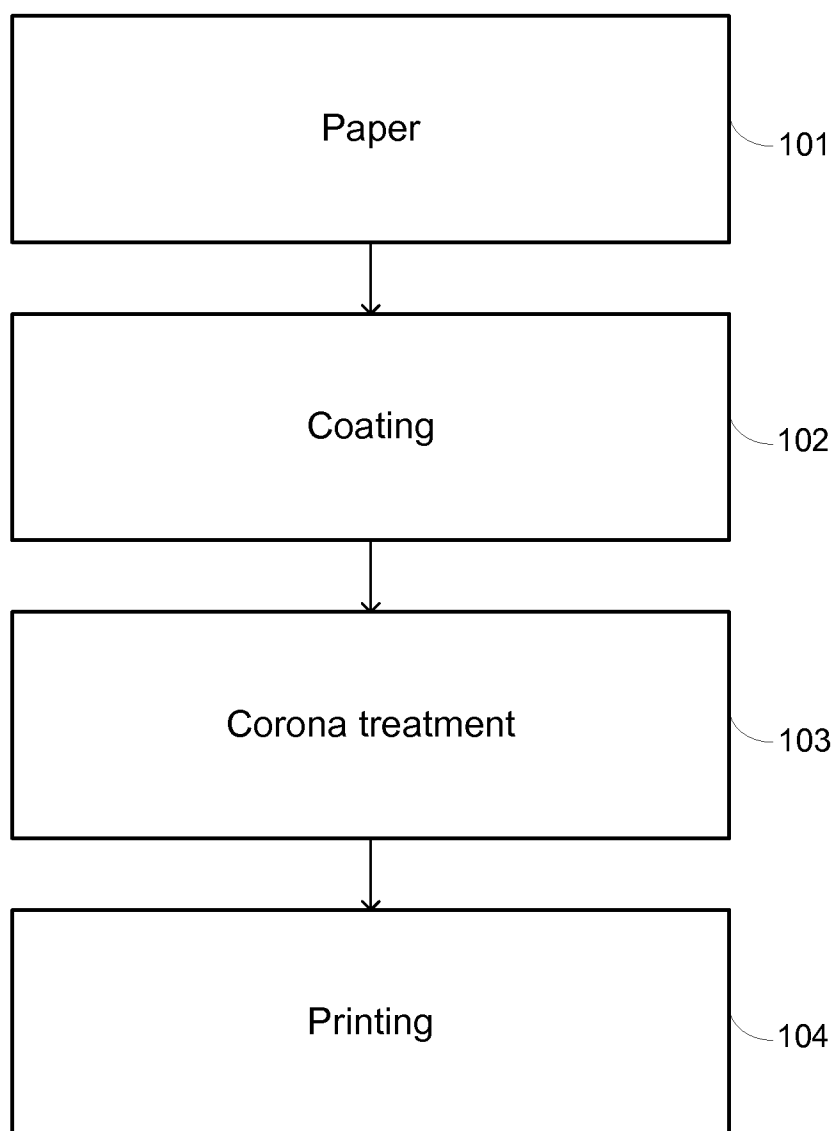
80. An apparatus according to claim 78, wherein the corona treatment comprises corona treatment of 200 W/min/m²; preferably 180 W/min/m²; most preferably 160 W/min/m².

5 81. An apparatus according to claim 78 further comprising an UV printing apparatus in order to provide printing onto the corona treated paper.

10 82. An apparatus according to claim 78 comprising an UV inkjet printing apparatus in order to print the corona treated paper.

83. An apparatus according to claim 78 comprising a corona treatment module in-line with the UV printing apparatus.

15

**Fig. 1**

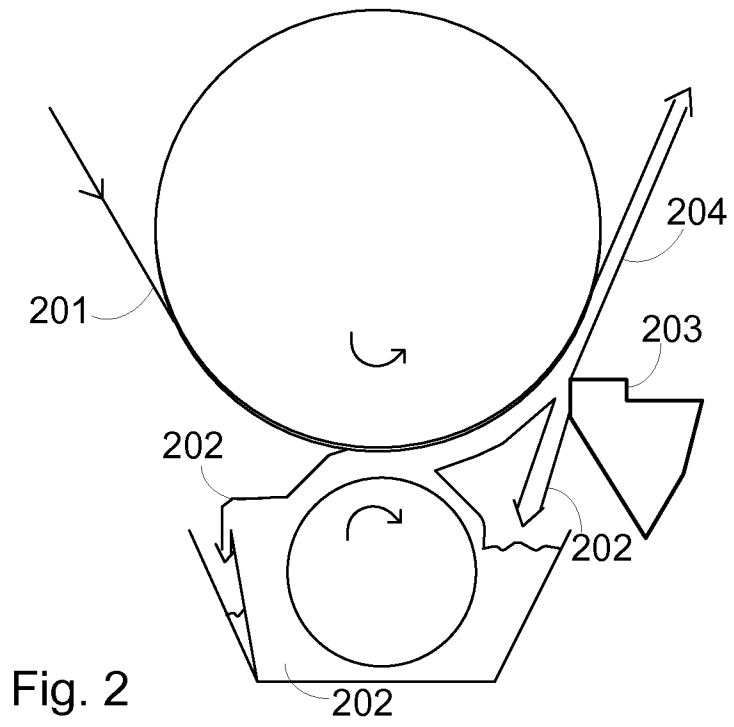


Fig. 3

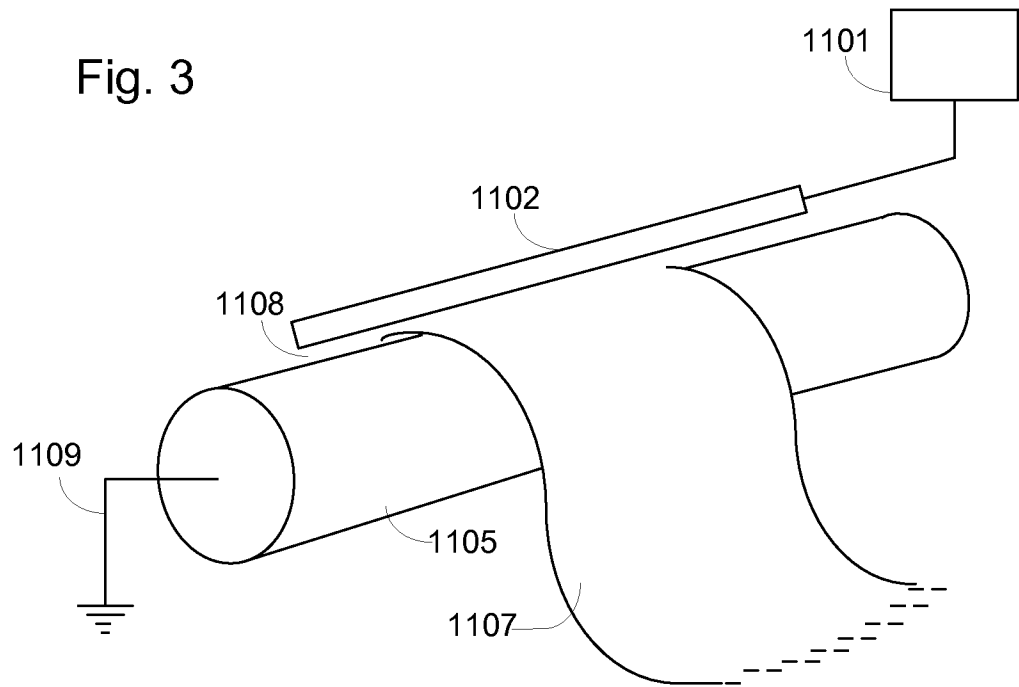
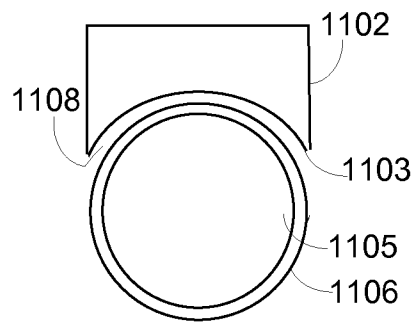


Fig. 4



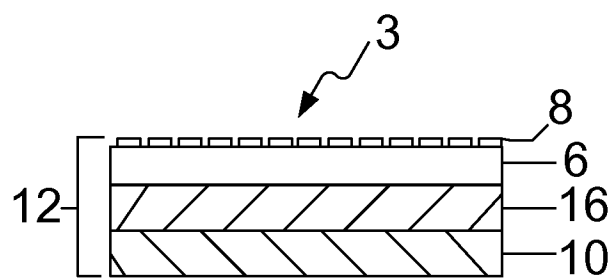
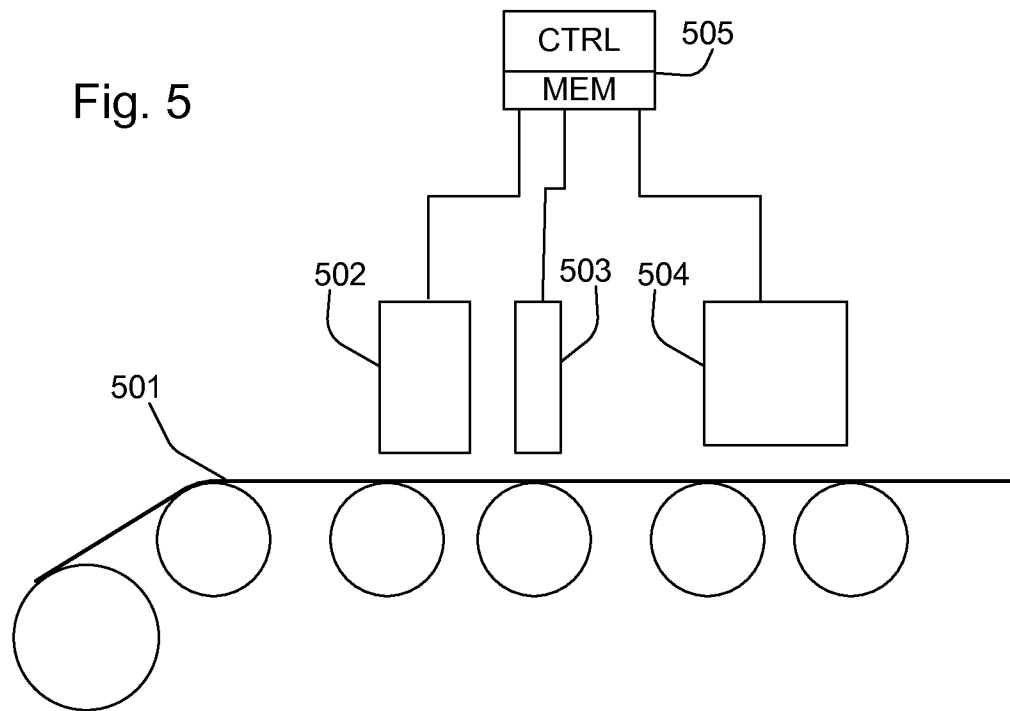


Fig. 6

INTERNATIONAL SEARCH REPORT

International application No.

PCT/FI2013/050030

A. CLASSIFICATION OF SUBJECT MATTER

See extra sheet

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)

IPC: D21H, B41M

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
FI, SE, NO, DK

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-Internal, WPI, XPESP, XPESP2, Paperbase

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP 2103736 A1 (AGFA GEVAERT [BE]) 23 September 2009 (23.09.2009) the whole document, especially example 13; claims 17-19	1-17, 19, 65-68, 73
X	JP 2012071501 A (JUJO PAPER CO LTD) 12 April 2012 (12.04.2012) & abstrac [online] EPOQUENET EPODOC & WPI & PAJ & machine translation into English (Thomson Scientific) EPOQUENET TXTJPT [online]; Example 1	1-18, 20-83
X	Pykönen, M. et al, Plasma activation induced changes in surface chemistry of pigment coating components, Colloids and Surfaces A, 2009, vol. 352, p. 103-112. XP 026761848 the whole document, especially chapter 2 "Materials and methods" and 3 "Results and discussion"	1-18, 20-42, 44-61, 65-68, 78-80



Further documents are listed in the continuation of Box C.



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

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search

06 November 2013 (06.11.2013)

Date of mailing of the international search report

07 November 2013 (07.11.2013)

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INTERNATIONAL SEARCH REPORT

International application No.

PCT/FI2013/050030

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	Bollström, R., Top layer coatability, Progress in organic coatings, 19.8.2011, vol. 73, p. 26-32. XP 028105445 p. 27-30; tables 3 and 4	1-18, 20-32, 35-43, 44-45, 47-61, 65-72, 78-80
X	The real cost-effective, hybrid UV inkjet label production machine [online publication] Stork Prints, Published March 2010 [retrieved 4.11.2013] Internet address: http://www.jet-technologies.com.au/attachment/division_pages/dsi%EF%BF%BD.pdf the whole document, especially p. 9	68-72 and 78-83

International application No.
PCT/FI2013/050030

Form PCT/ISA/210 (patent family annex) (July 2009)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/FI2013/050030

CLASSIFICATION OF SUBJECT MATTER

Int. Cl.

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D21H 19/36 (2006.01)

B41M 5/00 (2006.01)

B41M 5/52 (2006.01)