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(54) **PROCESS FOR PRODUCING SUPER HIGH BULK, LIGHT WEIGHT COATED PAPERS**
VERFAHREN ZUR HERSTELLUNG VON SUPERDICKGRIFFIGEN LWC-PAPIEREN
PROCEDE DE PRODUCTION DE PAPIERS COUCHES LEGERS ET TRES BOUFFANTS

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Description**FIELD OF INVENTION**

[0001] The present invention relates to a process of manufacturing a high bulk, low weight paper product having stiffness and opacity comparable to heavier weight sheets, the process consisting of using a high level of groundwood containing sheet, coating with specifically formulated coatings then passing the paper web through two extended-nip calenders, using one nip for each side of the paper.

BACKGROUND OF INVENTION

[0002] Due to the continue increase in bulk postage rates, a significant demand has been created for lighter paper stock suitable for magazine use. As paper stock is made lighter, however, the problem of "show-through" and a limp "feel" arise substantially precluding use of such lighter paper in magazines, brochures, annual reports, advertising pieces, direct mail and like promotional materials, especially in high quality magazines.

[0003] Attempts to make lightweight, high bulk paper have been made utilizing higher levels of groundwood and coating the paper web with a coating formulated with higher level of kaolin and plastic pigments or by using coating that tends to be bulkier than conventional coating. See for example U.S. Patent Nos. 6,287,424, 6,332,953, and 4,749,445. U. S. Patent No. 5,283,129 discloses a high gloss lightweight paper stock that is coated with a pigment composition including delaminated clay, calcined clay and titanium dioxide, wherein up to about 5 parts by weight of hollow core opacifying plastic pigment may be substituted for the titanium dioxide. U.S. Patent No. 4,090,307 discloses a high gloss coated paper product comprising 70-95% calcium carbonate and from 5-30% by weight of a non-film forming polymeric pigment having particles sized within the range of from 0.05-0.30 μm (microns).

[0004] In papermaking the finishing operation may be a calendering process, in which the paper web is passed between the nips formed between or more pairs of rolls and the surface of the web is thereby flattened to form a smooth surface. Simultaneously, the thickness, or caliper, of the paper web is reduced and the web is densified. Bulk is inversely related to density, therefore when the density is increased the bulk of the finished paper product will be reduced. Further attempts to make lightweight (10.19-18.14 kg) (24-40 pounds) high bulk coated paper have been made utilizing on-line hot soft calender, on-line supercalender, or off-line supercalender at reduced loading and nip number. See, for example, U.S. Patent Nos. 5,694,837, 5,750,259, 5,546,856, 5,400,707 directed to an apparatus for finishing a continuous sheet of paper; U.S. Patent No. 5,163,364, directed to a method for calendering a paper or cardboard web, and U.S. Patent application No. 09/839,507, directed to high bulk paper. See also, Wikstrom, M. "Calendering of coated paper and board in an extended soft nip. Nordic Pulp & Paper Research J. no. 4, P289-298 (1997); Carlsson, et al., "Influence of latex binder vis-coelastic properties on the high temperature calendering runnability. 2002 TAPPI Coating Conference, P-457; and Moreau-Tabiche et al., "Wood containing paper pilot calendering - obtained results through supercalendering, soft nip calendering, and extended nip concept TAPPI 2000 Coating Conference, P-245.

[0005] US-A-5,400,707 discloses a hot soft nip calender apparatus for a paper mill including at least one heated calender roller and a finishing belt which is moved in proximity to the heated calender roller by a plurality of drive rollers and at least one pressure roller.

[0006] US-A-5,283,129 relates to a light weight coated paper prepared with an aqueous coating formulation comprising delaminated clay, calcined clay, whitening pigment, starch binder, starch cross-linking agent, lubricant and water at a pH of about 8 to 8.5.

[0007] WO 01/98 585 discloses a calendering method for precalendering where a paper web is guided through a calendering nip formed between two surfaces, where in the nip heat is conducted on the surface of the web to be calendered and pressure is exerted thereon within a fixed length in the travel direction of the web.

[0008] However, such attempts to make lightweight, high bulk paper utilizing lower than conventional supercalendering nip pressures have resulted in papers that generally have low gloss, usually well below a 75° TAPPI gloss of 40, namely less than 35. Such lower gloss paper is not acceptable for many publication purposes, such as magazines where lightweight high bulk paper, with high gloss and good print gloss is desired.

[0009] Thus, current practices to increase bulk of paper include using a higher level of groundwood containing base and coating with an easy-finishing coating (i.e., formulated with a higher level of kaolin and plastic pigments then followed by supercalender at reduced loading and nip number. Analyzing current 17.61 kg (80 pounds) commercial samples indicates that the bulk of such paper is in a range of 43.18-48.26 μm (1.7-1.9 mils).

[0010] The prior art does not teach a process of making high bulk, lightweight coated paper having high stiffness, opacity and brightness that may be used as a "low end" offset paper. Thus, there is a strong need of developing a lower weight sheet with benefits of higher stiffness and opacity that are comparable to that of a heavier weight sheet.

BRIEF SUMMARY OF THE INVENTION

[0011] The need apparent in the art is met by the present invention, which provides a process of making a 0.0444 kg/m² (30 pounds/3300 square feet) super high bulk, lightweight coated (LWC) paper having high stiffness, opacity and brightness that may be used as a "low end" offset paper, which process consists of using high level of groundwood containing sheet, blade coating with specifically formulated coatings, followed by calendering with two extended-nip calenders, one calender for each side of paper.

[0012] Our data shows that the process of the present invention produces a super high bulk LWC, with up to 22% bulk improvement over the highest current commercial sheet. The extended-nip calendered paper of the present invention exhibits better brightness and opacity, and equivalent or better printing performance, specifically in the print gloss performance, than supercalendered counterparts. The significantly higher bulk resulting from the use of two extended-nip calenders is largely due to better bulk preservation of the extended-nip calender, that is, under an equivalent loading using two extended-nip calenders gives lower nip intensity than supercalender and hot soft calender.

[0013] Thus, an object of the invention is to provide a process for making a super high bulk, offset lightweight coated paper, comprising the steps of:

- (a) creating a fiber furnish comprising mechanical pulp and chemical pulp;
- (b) forming a paper web from the fiber furnish;
- (c) removing water from said web;
- (d) applying the coating formulation of the present invention
- (e) calendering by passing the coated web through the nips of two extended-nip calenders, with each side of paper facing a heated roll and treated with one of said calender nips; whereby each calendering nip is formed by a calender roll having a surface temperature of at least 422 K (300°F) and a backing shoe having a width of at least 30 mm, the nip providing loading of at least 178.6 kg per cm (1000 pounds per linear inch), and whereby the calendered paper has a caliper preservation greater than 75%.

[0014] Another object of the Invention is to provide a process for making a 0.0444kg/m² (30 pounds/3300 square feet) super high bulk, No. 5 offset lightweight coated paper.

[0015] Another object is to provide a furnish comprising at least 40% mechanical pulp, preferably 60% mechanical pulp, wherein the mechanical pulp portion comprises an equal blend of thermal mechanical pulp (TMP) and a conventional stone groundwood pulp, and wherein the remaining makeup is Kraft.

[0016] A further object of the present invention is to provide a process for making a super high bulk, offset lightweight coated paper, wherein the coating formulation is preferably applied using a blade coater or a metering size press.

[0017] Another object of the invention is to provide a process for making a super high bulk, offset lightweight coated paper, wherein the coating formulation consists of (i) a hollow plastic pigment; (ii) a kaolin pigment; (iii) a calcined kaolin clay; (iv) a titanium dioxide (TiO₂) pigment; (v) a synthetic latex binder, and (vi) a synthetic thickener (or a co-binder including carboxymethylcellulose (CMC) or acrylic acid based or associative based thickeners.

[0018] Another object is to provide a coating formulation wherein said hollow plastic pigment, in an amount of at least about 2% by weight, and preferably 3 to 5% by weight of the total amount of pigments.

[0019] Another object is to provide a coating formulation wherein said kaolin pigment is at least about 70% by weight, preferably 80-100% by weight of the total amount of pigment, and has a fine particle size distribution characterized by at least 85% of said particles are less than 2 microns and at least 50% of said particles are less than 0.5 μm (microns), based upon particle count using a Sedigraph particle size analyzer, and wherein said kaolin pigment has a platy morphology characterized as both fine and coarse particles having a shape factor greater than 15, preferably 20-27.

[0020] Another object is to provide a coating formulation wherein said calcined kaolin is at least about 5% by weight of the total amount of pigment.

[0021] Another object is to provide a coating formulation wherein said TiO₂, in an amount of at least about 2% by weight and preferably 3 to 5% by weight of the total amount of pigment.

[0022] Another object is to provide a coating formulation wherein said synthetic latex is in a concentration of at least about 12 or more parts by weight of the total amount of pigment.

[0023] Another object is to provide a coating formulation wherein said synthetic thickener is in a concentration of at least about 0.05 or more parts by weight of the total amount pigment.

[0024] Another object is to provide a coating formulation which coating may also comprise precipitated calcium carbonate (PCC) or ground calcium carbonate (GCC).

[0025] Another object of the present invention is to provide a coating having a weight of at least 0.00293 kg/m² (2.0 pounds per 3300 square feet) preferably 0.00293 to 0.0889 kg/m² (2.0 to 60 pounds per 3300 square feet) and most preferably 0.00391 to 0.0083 kg/m² (2.5 to 5.5 pounds. per 3300 square feet) per side onto each surface of said web to form a coated web having a moisture content prior to calendering of at least 5.5%, preferably 6.5-8.0%, and most

preferably 7.0%, the coating comprising a fine, platy kaolin pigment, a latex binder, and a thickener, said coated web having a caliper greater than 66,04 μm (2.6 mils).

[0026] Another object of the present invention is to provide a process for making a super high bulk, offset lightweight coated paper, while preserving significantly more of the original bulk than traditional supercalender or hot soft calenders, the calendering step is carried out using two extended-nip calenders, wherein the calender is preferably a shoe nip calender (SNC), said shoe nip width being in the range of from about 40 mm to about 80 mm, and calendering temperature controlled at about 422 K (300°F) to about 444.0 K (430°F) and nip loading at 303.6-428.6 kg per cm (1700-2400 pli).

[0027] Another object of the present invention is to provide a process for making a super high bulk offset lightweight coated paper, wherein the finished coated paper has a basis weight of 0.0415 to 0.05615 kg/m² (28 to 38 pounds per 3300 square feet) and exhibits a 75° TAPPI gloss of 35% or above and a caliper of at least 54.61 μm (2.15 mils).

[0028] Another object of the present invention is to provide a process for making a super high bulk, offset lightweight coated paper wherein the LWC gives a 17-27% higher caliper than that of a supercalendered 0.0444 kg/m² (30 pounds/3300 square feet) LWC and has improved brightness, opacity and printing gloss.

[0029] Another object of the present invention is to provide a process for making a super high bulk, offset lightweight coated paper, wherein said extended-nip, shoe calender produces a No. 5 LWC offset sheet with up to 22% bulk improvement relative to its supercalendered counterparts, while providing better brightness and opacity, as well as providing comparable or better printing performance.

BRIEF DESCRIPTION OF THE DRAWINGS

[0030]

FIG. 1 is a graph that illustrates the effect of calendering on caliper performance. The graph shows that papers calendered with shoe nip calender show significantly higher caliper.

FIG. 2 is a graph that illustrates the effect of calendering on brightness performance. The graph shows that samples that are finished in a shoe nip calender clearly give higher brightness than those that are finished in a supercalender.

FIG. 3 is a graph that illustrates the effect of basepaper on opacity performance

FIG. 4 is a graph that illustrates the effect of coating on gloss performance.

FIG. 5 is a graph that illustrates Parker Print Surf (PPS) performance. The graph shows that the PPS performance is not only dependent on calendering method, but also on types of basepaper and coating.

FIG. 6 is a graph that illustrates the effect of coating on print gloss measurements.

DESCRIPTION OF THE INVENTION

[0031] The process of the Invention produces a low weight paper product having a relatively high bulk, therefore producing a thicker sheet of reduced density or compaction, while maintaining the benefits of higher stiffness and opacity that are comparable to that of a heavier weight sheet

[0032] In the process of the present invention, a basepaper is produced with a high level of mechanical pulp. The process further comprises a coating formulation composed of a pigmentation containing (i) hollow plastic pigments in an amount of at least 2% by weight of the total amount of pigments (ii) platy or fine particle engineered kaolin in an amount of at least 70% by weight of the total amount of pigment, (iii) TiO₂ in an amount of at least 2% by weight of the total amount of pigment, and (iv) calcined clay in an amount of at least 10% of the total amount of pigment. Binders include 14-20 parts by weight of total pigment bi-modal particle size distribution styrene butadiene (PSD SB) latex or SB latex with Acronitrile modification. Co-binders include CMC, acrylic acid based, or associative based thickeners. The coating formulation is applied using blade coater or a metering size press at coat weights ranged from about 0.00391 to 0.0083 kg/m² (2.5 to 5.5 pounds/3300 square feet). The process of the present invention further comprises a calendering step, which is done using two extended-nip calendars, with one nip per side, in which the coated side of the paper faces the thermal rolls with temperature ranged from 433.2 K (320° F) to 488.7 K (420°F). Line loadings are ranged from about 260-464.3 kg per cm (1400-2600 PLI). Sheet moisture prior to calendering is controlled at about or above 6.5%. The resulting paper exhibits better brightness and opacity than supercalendered counterparts. Printing performance is equivalent or better than supercalendered counterparts, specifically in print gloss performance.

FIBER FURNISH

[0033] The LWC paper, manufactured using the process of the present invention, would start with a waterborned furnish having a high percentage of mechanical pulp with the remaining makeup is Kraft. The mechanical pulp is generally about at least 40%, usually in the 40% to 80% range, and preferably in the range of 60% to 80%. The mechanical pulp portion comprises an equal blend of thermal mechanical pulp and conventional stone groundwood pulp. The remaining composition is Kraft Mechanical pulp gives a well-formed base. As used herein, the term mechanical pulp may include stone ground wood (SGW), thermal mechanical pulp (TMP), and chemi-thermal mechanical pulp (CTMP). Sample furnish formulations are: (1) 30% TMP/30% SGW/40% softwood Kraft (SWK) and (2) 60% TMP/10% PGW 30% SWK. SWK is not considered a mechanical pulp. Another example might be 55%-65%CTMP/35%-45% SWK.

[0034] A paper sheet is created from the above furnish using conventional papermaking equipment The paper sheet then moves into the press section wherein it can be conventionally pressed. The web is then sent through the dryer section and dried to a moisture content of below 6% and preferably to 4% or less. The paper may then be coated on or off the papermaking machine with the coating formulation of the present invention.

COATING FORMULATION

[0035] In the process of the present invention, a coating formulation is applied before finishing. The coating formulation according to the present invention comprises (i) a hollow plastic pigment; (ii) a kaolin pigment; (iii) a calcined kaolin clay; (iv) a titanium dioxide (TiO₂) pigment; (v) a synthetic latex binder, and (vi) a synthetic thickener (or a co-binder including carboxymethylcellulose or acrylic acid based or associative based thickeners. The coating formulation may also comprise precipitated calcium carbonate (PCC) or ground calcium carbonate (GCC)

[0036] The hollow plastic pigment is in an amount of at least 2% by weight, and preferably about 3-5% by weight of the total amount of pigments. Suitable hollow plastic pigments include ROPAQUE HP-1055[®], supplied commercially by ROHMNOVA 2990 Gilchrist Road, Akron, Ohio 44305. The kaolin pigment is at least about 70% by weight, and preferably 80-100% by weight of the total amount of pigment, and is preferably engineered with a fine particle size and very platy morphology. The kaolin pigment has a fine particle size distribution characterized in that at least 85% of the particles are less than 2 μm (micron) and at least 50% of the particles are about less than 0.5 μm (microns) based upon particle count using a Sedigraph particle size analyzer. The kaolin has a platy morphology characterized as both fine and coarse particles having a shape factor greater than 15, preferably about 20 to 27, Shape factor was calculated based on the method described by Sven Lohmander, "Aspect Ratios Of Pigment Particles. Determined By Different Methods," Nordic Pulp And Paper Research, Vol. 15, No.3/2000, pg. 221. Suitable kaolin pigments include CONTOUR 1500[®], supplied commercially by Imerys, Rt-1, Dry branch, Georgia 31020. The calcined kaolin clay is at least 5% by weight of the total amount of pigment. Suitable calcined pigments include ANSILEX 93[®], supplied by Engelhard, 101 Wood Avenue, Iselin, New Jersey 08830. The TiO₂ pigment is in an amount of at least 2% by weight and preferably about 3-5% by weight of the total amount of pigment Suitable TiO₂ pigments include RPS VANTAGE[®], supplied by Dupont. The synthetic latex binder is at a concentration of at least about 12 or more parts by weight of the total amount of pigment Suitable synthetic latex binders include STYRONAL 4681[®], supplied commercially by BASF, 11501 Steele Creek Road, Charlotte, North Carolina 28273. The synthetic thickener is at a concentration of at least about 0.05 parts or more by weight of the total amount of pigment (or a co-binder including carboxymethylcellulose (CMC) or acrylic acid based or associative based thickeners). Suitable synthetic thickeners include STEROCOLL FD[®], supplied commercially by BASF. The coating formulation may also comprise PCC or GCC. Supplied commercially by Minerals Technologies, Inc., 9 Highland Avenue, Bethlehem, Pennsylvania 18017 and Omya, 61 Main Street, Proctor, Vermont 05765.

[0037] The coating formulation may be prepared by mixing together the various ingredients in a one-tank make down or by pre-mixing then combining separate ingredients. The mixture is generally agitated to homogenize the ingredients. The resulting formulation may be of a viscosity ranging from about 17 Pa.s (1000 cPs) to about 1.5 Pa.s (1500 cPs) measured by a Brookfield viscometer at 100 rpm. The solids content of the coating formulation when it is used, for example, in a blade coater, may desirably be as high as from about 53% to about 55% by weight; however, because the plastic pigment is typically added to the formulation in the form of an aqueous dispersion having a low solids content, the solids content of the coating formulation is more usually in the range of about 49% to about 51% by weight. A sample coating formulation is:

91% CONTOUR 1500[®],
5% RPS VANTAGE[®],
4% ROPAQUE HP-1055[®],
14 parts STYRONAL 4681[®], and
0.7 parts STYROCOLL FD[®] at 50% coating solids and 1 Pa.s (1000 cPs) Brookfield viscosity.

[0038] The coating formulation should be applied at a weight of about 0.00293 to 0.00879 kg/m² (2.0 to 6.0 pounds/3300 square feet) and preferably 0.00391 to 0.0083 kg/m² (2.5 to 5.5 pounds/3300 square feet). The coating formulation is generally, but need not be, applied to both sides of the paper web. Generally, the coating formulation can be applied with any conventional type blade coating as shown in U.S. Pat. Nos. 4,250,211 and 4,512,279, and/or a fountain type coater shown in US Pat. No. 5,436,030 and/or a double bladed coater as shown in US Pat. No. 5,112,653, the teachings of which patents are incorporated herein by reference. In addition, the coating formulation can be applied using a metering size press, such as the Metso's Optisizer. The term blade or blade coater as used herein, unless specifically stated, is understood to include such other equivalent metering techniques. The doctor blade shown in US Pat. No. 4,780,336 has been advantageously used to provide low coat weight. Preferably, the coating formulation is applied using a blade coater, in a substantially uniform thickness over the surface of the base stock. Preferably, the coating process is carried out off-line or in-line. Prior to calendering, the coated web has a moisture content greater than 5.5%, preferably 6.5%, most preferably 7.0%.

EXTENDED-NIP CALENDER

[0039] The coated paper can then be calendered, using two extended-nip calenders, preferably using a shoe nip calender (SNC), that comprises a heated roll and a soft shoe backing, as shown in U.S. Patent Nos. 6,332,953, 6,465,074 and 6,213,009 the teachings of which patents are incorporated herein by reference. In this type of calender the nip is formed between a cylindrical press roll and an arcuate pressure shoe. The latter has a cylindrically concave surface having a radius of curvature close to that of the cylindrical press roll. When the roll and shoe are brought into close physical proximity to one another, a nip, which can be five to ten times longer in the machine direction than one formed between press rolls, is formed. This increases the so-called dwell time of the cellulosic fibrous web in the long nip while maintaining an adequate level of pressure per square inch of pressing force. The use of a shoe nip calender preserves significantly more of the original bulk than traditional supercalender or hot soft calenders.

[0040] The coated paper passes through the two calendering nips, with each side of paper facing a heated roll and treated with one of said calender nips; each calendering nip being formed by a calender roll having a surface temperature of at least 422 K (300° F) and a backing shoe having a width of at least 30 mm, the nip providing loading of at least 178.6 kg per cm (1000 pounds per linear inch); the calendered paper having a caliper preservation greater than 75%.

[0041] The resultant coated paper will generally have the following characteristics as compared to conventional coated paper of the same weight

- (1) up to 4.0% higher brightness
- (2) up to 3.3% higher opacity;
- (3) Up to 22% higher caliper,
- (4) 1%-7% lower paper gloss but comparable or 2%-5% higher print gloss;
- (5) slightly rougher surfaces, that is, 1.6-2.6 μm (microns) as measured by PPS, at 10Kg clamping pressure. (Commercially acceptable PPS of 1.6-1.9 μm (microns), were obtained using coatings A or B below.)
- (6) lesser weight per roll for the same roll diameter, evidencing the higher bulk of the paper

EXAMPLES

BASEPAPER

[0042] The effect of five 32 g/m² basepaper was examined using the following types of basepaper: B1, B1/hi-mechanical, B4 and two hot soft pre-calendered basepaper (B1/precalendering and B1/hi-mechanical/precalendering). The properties of the B1 and B1/hi-mechanical basepaper are shown in Table 1. B4 basepaper is similar to B1 basepaper, except that the B4 has less addition of wet-end starch in the sheet. Precalendering basepaper has smoother surfaces than non-precalendered basepaper, but its caliper is reduced. Table 1 shows that by increasing TMP content from 30% to 60% the total mechanical pulp content increases from 60% to 70%, while still maintaining good paper machine runnability. Table 2 shows that by increasing the amount of mechanical pulp from 60% to 70% the caliper increases from 2.85 to 3.03, while roughness and porosity are slightly increased.

COATING FORMULATIONS

[0043] The "control" coating is a typical No.5 lightweight coating, consisting of: 79% standard delaminated kaolin with 80% less than 2 μm (micron) and a median particle size of 0.75 μm (microns) using a Sedigraph particle size analyzer, 7 % of 93% brightness calcined kaolin, 7.5% TiO₂; 6.5% of a hollow plastic pigment; 8 parts starch; and 12 parts styrene butadiene (SB) latex at 50.7% coating solids.

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[0044] Coating A consists of 86% fine platy kaolin with 90% less than 2 μm (microns) and a median particle size of 0.5 μm (microns) using a Sedigraph particle size analyzer, 5.5% of a hollow plastic pigment; 14 parts latex containing styrene butadiene with acronitrile monomer (SBA_n); and 0.25 part of synthetic thickener at 53.9% solids.

[0045] Coating B consists of 76% a coarse platy delaminated kaolin with 60% less than 2 μm (microns) and a median particle size of 1.6 μm (microns); 10% of 93% brightness calcined kaolin; 8.5% of TiO_2 5.5% of a hollow plastic pigment; 12 parts SBA_n latex; and 0.25 part of synthetic thickener at 51.1 % solids.

[0046] Coating C consists of 86% fine engineered kaolin with 99% less than 2 μm (microns) and a median particle size of 0.21 μm (microns); 8.5% of TiO_2 ; 5.5% of a hollow plastic pigment; 16 part of SBA_n latex; and 0.25 part of synthetic thickener, at 55.6% solids.

COATING PROCESS

[0047] Using a shortdwell blade coater, the coatings, as described Table 3 below, were applied on the basepapers shown in Tables 1 and 2. The coat weights were targeted at 5.7 g/m² on the wire side of paper and 4.9 g/m² on the felt side of paper. The wire side was coated first and followed by felt side. With the exception of the B4 basepaper, which was coated at 18.79 m/s (3700 fpm), all the basepapers were coated at 10.66 m/s (2100 fpm). The final coated sheet moisture content was controlled at 5.5-6.0%.

Table 1 - Basepaper Properties

	B1 Std	B1/hi-mechanical
Furnish	40 Kraft, 30 TMP, 30 GWD	30 Kraft, 60 TMP, 10 GWD
Other Furnish	18 Coated Broke, 5 Return Broke	5 Coated Broke, 5 Return Broke
Rawstock Ash (%)	5.7	3.1
Porosity(s)	21	23.7
Smoothness (SU) Top/Wire	235/292	245/299
Formation	29.9	31.3
Opacity (%)	75.8	75.2

Table 2 - Basestock Comparisons

Basestock	Caliper (μm) (mils)	Gurley Porosity(s) Mean/S.D.	PPS10kg Wire Side	PPS10kg Felt Side
B1	72.39 (2.85)	20.2/3.1	8.11	6.26
B1/Pre-Calendering*	55.63 (2.19)	25.8/2.6	4.89	3.84
B4	63.5 (2.50)	22.9/2.9	5.56	5.63
B1 with hi-Mechanical	76.96 (3.03)	25.5/2.8	8.52	6.56
B1 with hi-Mechanical And pre-Calendering*	62.48 (2.46)	27/2.5	6.05	4.86
*Hot soft pre-calendering was done using one nip per side at 449.8 K (350° F) and 103.4 kPa (15 psi)				

Table 3 - Coating Formulations

	CONTROL (BLADE)	A (BLADE)	B (BLADE)	C (BLADE)
Standard delaminated	79			
Fine platy		86		
Coarse platy			76	
Fine engineered				86

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(continued)

	CONTROL (BLADE)	A (BLADE)	B (BLADE)	C (BLADE)
Ansilex 93	7		10	
TiO ₂	7.5	8.5	8.5	8.5
Ropaque 1055	6.5	5.5	5.5	5.5
SB Latex	12.5			
SBA _n Latex		14	12	16
Starch	8			
Thickener No. 1		0.05	0.05	0.05
Thickener No. 2		0.2	0.2	0.2
Coating Solids(%)	50.7	53.9	51.1	55.6

CALENDERING PROCESS

[0048] The above-coated papers were calendered at 15.24 m/s (3000 fpm) using the Optidwell shoe-nip calender, manufactured by Metso Paper Inc. The calendering process was done one-nip-per-side with the wire side calendered first and followed by felt side. The thermal roll temperature for the first nip was 443.8 K (350°F) and 70 mm nip width the 2nd nip was 477.6 K (400°F) and 70 mm nip width. The loading for the 1st and the 2nd nips was 410.7 kg per cm (2300 pli).

[0049] In addition, the papers coated with the "control" coating were also calendered using a conventional supercalender at 5.08 m/s (1000 fpm). The supercalendering roll temperature was at 360.9 K (190° F) and nip loading was adjusted so that a 45% sheet gloss can be obtained with the B1 basepaper sample. The same supercalendering conditions were also used with the B4 basepaper that was coated with the "control" coating.

COATED PAPER PROPERTIES

[0050] All coated sheet properties are shown In Figures 1-6. Printing performance was assessed using a four-color web offset press at Rochester Institute of technology (RIT), Rochester, NY. Several commercial 13.61 kg (30 pounds) products were also printed at RIT for comparison purposes. Typical 14.51 kg (32 pounds) to 40 LWC paper properties, or industry averaged properties, were also summarized and included in the figures for comparisons.

CALIPER (FIGURE 1)

[0051] Samples made with the B1 and B4 basepaper coated with the "control" coating and calendered in a supercalender showed 45.72-46.48 μm (1.80-1.83mils) caliper, in line with that of commercial products made with the same basepaper and coated with the "control" coating. The same samples calendered in a shoe nip calender showed significantly higher caliper (55.37-55.88μm) (2.18-2.20 mils), which is approximately a 22% improvement. The 13.61 kg (30-pounds) SNC coated samples prepared with the B1/hi-mechanical basepapers have the highest caliper, equal to or marginally better than that of a typical 18.14 kg (40 pounds) LWC product. The 13.61 kg (30-pounds) SNC coated samples prepared with the precalendered papers have lower caliper than their uncalendered counterparts, but are still in a range of typical 16.33-17.24 kg (36-38 pounds) LWC products. The 13.61 kg (30-pounds) SNC coated samples prepared with the B1 basepaper have caliper close to a typical 18.14 kg (40 pounds) LWC sheet. The 13.61 kg (30-pounds) SNC coated samples prepared with the B4 basepaper have slightly lower caliper than those prepared with the B1 basepaper, but are comparable to a typical 17.24 kg (38 pounds) LWC sheet.

[0052] Compared to samples that were coated with either coating A or coating C, samples that were coated with

coating B, consisting of a coarse platy kaolin and a calcined kaolin, have improved caliper. Overall, the 13.61 kg (30-pounds) SNC papers, regardless of whether they are made with precalendered basepaper or not, have significantly improved caliper, that is, caliper is 17-27% higher than that of a supercalendered counterparts (13.61 kg) (30 pounds). As shown in Figure 1, the main contributor of the significantly better caliper is the superior bulk preservation of the shoe calender. Thus, increasing initial bulk of the paper along with the use of the shoe calender can produce the highest final caliper.

[0053] In summary, Figure 1 shows that the samples that were calendered using a shoe-nip calender and that were coated with the "control" coating exhibited about 22% higher caliper than their supercalendered counterparts. The samples that were calendered using a shoe-nip calender and that were coated with either coating A, B, or C, exhibited about 12-22% higher caliper (53.85-58.93 μm caliper) (2.12-2.32 mils caliper) than the highest-caliper commercial sheet that was used for the comparison, that is, the 30# Mainebulk. The effect of coating formulation on bulk was relatively small with only the samples that were coated with coating B producing a marginally higher bulk. The effect of basepaper on bulk was largely expected, that is, pre calendered basepaper produced a lower caliper and a higher mechanical pulp containing basepaper produced a higher bulk. Overall, the B1/hi-mechanical basepaper gave the highest bulk, and followed by B1 basepaper, B4 basepaper, B1/hi-mechanical/precalendering basepaper, and then B1/precalendering basepaper,

BRIGHTNESS (FIGURE 2)

[0054] The higher caliper of noncalendered basepapers produce a higher brightness than precalendered basepapers. When compared the samples that were coated with the "control" coating, the samples finished in SNC clearly have higher brightness than supercalender samples. This is due to the relatively mild pressure and significantly fewer nips of the shoe nip calender. Samples that were coated with either coating A or coating B have similar brightness performance and are better than samples that were coated with coating C. In general, the brightness of the SNC samples is in a range of 72.7-74.5%, which is significantly better than the commercial samples 13.61 kg (30 pounds) as well as industry samples (14.51-18.14 kg) (32-40) pounds).

[0055] In summary, Figure 2 shows that the shoe-calendered papers coated with the "control" coating exhibited about 1.1-3.1 points higher brightness than their supercalendered counterparts. Substituting the "control" coating with coating A produced 0.2-0.6 points higher brightness. Samples that were coated with coating B produced comparable brightness. Samples that were coated with coating C produced 0.3-0.5 points lower brightness. Increasing the mechanical pulp in the basepaper reduced brightness. Precalendering basepapers gave comparable or slightly better brightness than their non-precalendering counterparts. Overall, superior brightness was obtained with the samples that use B1, B1/precalendering, or B1/hi-mechanical/precalendering basepapers and that were coated with either coating A or coating B.

OPACITY (FIGURE 3)

[0056] Similar to brightness performance, opacity is also highly dependent on the type of basepaper. The uncalendered basepapers (B1 and B4), specifically those with higher mechanical pulp content, produce a higher opacity. Samples coated with either coating A or coating B (both consisting of platy kaolin) have similar opacity and both give higher opacity than the samples that were coated with coating C or sample that were coated with the "control" coating. Except for the samples coated with coating C and made with the B4 basepaper, the opacity of the SNC samples is significantly better than the commercial samples (13.61 kg) (30 pounds) and the industry samples (14.51-18.14 kg) (32-40) pounds).

[0057] In summary, Figure 3 shows that the shoe-calendered papers that were coated With the "control" coating exhibited about 2.0-2.5 points higher opacity than their supercalendered counterparts. Substituting the "control" coating with either coating A or coating B on basepapers (Including B1, B1/precalendering, B1/hi-mechanical, and B1/hi-mechanical/precalendering basepapers), produced about 1 point higher opacity than samples that were coated with coating C, which produced about 1 point lower opacity. Precalendering bases produced 0.1-0.8 points lower opacity than their non-precalendering counterparts. Overall, samples that were coated with coating A and made with the B1/hi-mechanical basepaper gave the highest opacity, followed by those sample that were coated with either coating A or coating B and made with the B1, B1/precalendering, or B1/hi-mechanical/precalendering basepaper.

75° TAPPI SHEET GLOSS (FIGURE 4)

[0058] Samples coated with the "control" coating that were finished in a SNC have a significantly lower gloss than those that were finished in a supercalender. In fact, the SNC samples only have 31-33% gloss, significantly lower than 13.61 kg (30 pounds) commercial samples. Further, the gloss performance of the starch-containing "control" coating is poorer than the non-starch-containing coatings A, B, and C. The only samples that were able to reach 40% gloss were those that were coated with either coating A or coating C. In general, the smoother surfaces and lower porosity of B4

and precalendered basepapers gave improved sheet gloss. Samples that were prepared with B4 basepaper and coated with coating C had the highest gloss (50%).

[0059] In summary, Figure 4 shows that the shoe-calendered papers coated with the "control" coating exhibited about 15-20 points lower paper gloss than their supercalendered counterparts. Substituting the "control" coating with coating A produced about 9-12 point higher paper gloss; substituting with coating B, produced about 2-5 points higher paper gloss; and substituting with coating C, produced about 12-17 points higher paper gloss.. Precalendering produced 2-5 points higher sheet gloss. Overall, papers coated with coating C have higher gloss than those coated with coating A, and papers coated with coating B have the lowest paper gloss.

10 SURFACE SMOOTHNESS AS MEASURED BY PARKER PRINT SURF (FIGURE 5)

[0060] Samples that were coated with the "control" coating, and that were finished in a SNC have poorer Parker Print Surf (PPS), or rougher surfaces, than those that were finished in a supercalender. The PPS performance is not only depending on calendering method, but also on types of basepaper and coating. For example, a rougher basepaper like the B1 basepaper, gives poorer PPS than a smoother basepaper like the B4 paperpaer. For the same reason, precalendering which improved the smoothness of the basepaper also improves the PPS compared to uncalendered basepapers. The coatings A and B, consisting of platy kaolin, give better PPS than coating C consisting of fine-engineered kaolin. Thus, SNC samples give poorer PPS than commercial samples (13.61 kg) (30 pounds) as well as average industry samples (14.51-18.14 kg) (32-40 pounds).

[0061] In summary, Figure 5 shows that the shoe-calendered papers coated with the "control" coating exhibited about 0.1-0.9 points higher PPS than their supercalendered counter-parts. Substituting the "control" coating with coating A reduced PPS by about 0.1-0.6 points. Substituting with coating B reduced PPS by about 0.1-0.4 points. Substituting the "control" coating with coating C gave 0.2-0.3 points higher PPS. Precalendering reduced PPS by 0.1-0.5 points. Overall, all basepapers coated with either coating A or coating B gave commercially acceptable PPS, that is, 1.6-1.9 μm (microns).

25 PRINT GLOSS (FIGURE 6)

[0062] The print gloss is measured on a four-color black area using a RIT web offset press print signature. When compared to samples coated with the "control" coating, it is found that supercalendered samples have higher print gloss than SNC samples, largely due to the higher sheet gloss of supercalendered samples. Print gloss performance, similar to sheet gloss, is also dependent on the smoothness and porosity of basepapers, that is, the smoother surfaces and lower porosity of the B4 and precalendered basepapers give improved print gloss. Coatings A, B, and C give better print gloss than the "control" coating. SNC samples In general exhibit comparable or better print gloss than 13.61 kg (30 pounds) commercial sheets. Among all SNC samples, the samples that were prepared with the B4 basepaper and were coated with coating A exhibited the highest print gloss.

[0063] In summary, the shoe-calendered papers coated with the "control" coating exhibited about 7 points lower print gloss than their supercalendered counterparts. Substituting the "control" coating with coating A gave 10-12 points higher print gloss; 4-8 points higher with coating B; and 4-10 points higher with the coating C. Precalendering produced 1-5 points higher print gloss. Overall, the shoe-calendered papers that are coated with either coating A, B, or C gave at least comparable print gloss to commercial sheets.

[0064] Although the invention has been described with reference to preferred embodiments, which should be construed in an illustrative and not limiting sense, it will be appreciated by one of ordinary skill in the art that numerous modifications are possible in light of the above disclosure. For example, different latex and pigments may be used. All such variations and modifications are intended to be within the scope the invention.

Claims

1. A process for manufacturing a lightweight, high bulk coated paper, comprising the steps of:

- (a) creating a fiber furnish comprising mechanical pulp and chemical pulp;
- (b) forming a paper web from the fiber furnish;
- (c) removing water from said web;
- (d) applying a coating having a weight of at least least 0.00293 kg/m² (2.0 pounds per 3300 square feet) per side onto each surface of said web to form a coated web having a moisture content greater than 5.5%, and a caliper greater than 66.04 μm (2.6 mils).
- (e) passing the coated web through two extended-nip calenders, with each side of the paper facing a heated roll and treated with one of said calender nips, and

wherein each calendaring nip is formed by a calender roll having a surface temperature of at least 422 K (300°F) and a backing shoe having a width of at least 30 mm, the nip providing loading of at least 178.6 kg per cm (1000 pounds per linear inch); and whereby the calendered paper has a caliper preservation greater than 75%.

2. A process as in Claim 1 wherein the coating comprises a platy kaolin as a pigment.
3. A process as in Claim 2 wherein said kaolin pigment has a fine particle size distribution **characterized in that** at least 85% of said particles are less than 2 μm (microns) and at least 50% of said particles are less than 0.5 μm (microns), based upon particle counting using a Sedigraph particle size analyzer.
4. A process as in Claim 2 wherein said kaolin pigment has a platy morphology **characterized** as both fine and coarse particles having a shape factor greater than 15.
5. A process as in Claim 2 wherein said kaolin pigment has a platy morphology **characterized** as both fine and coarse particles having a shape factor of about 20 to 27.
6. A process as in Claim 1 wherein said coating comprises a hollow plastic pigment; a kaolin pigment; a calcined kaolin clay; a titanium dioxide pigment; a synthetic latex binder; and a synthetic thickener, or a co-binder including carboxymethylcellulose or acrylic acid based or associative based thickeners.
7. A process as in Claim 1 wherein the calender is a shore nip calender, said shoe nip width being in the range of from about 40 mm to about 80 mm, and calendaring temperature is at least 422 K (300° F), and nip loading at 303.6-428.6 kg per cm (1700-2400 pli).
8. A process for manufacturing a super high bulk, offset lightweight coated paper, comprising
 - (a) creating a fiber furnish comprising at least 40% mechanical pulp;
 - (b) forming a paper web from the fiber furnish;
 - (c) removing water from said web;
 - (d) applying a coating using a blade coater at coater at coat weights of at least 0.00293 kg/m² (2.0 pounds per 3300 square feet), per side onto each surface of said web to form a coated web having a moisture content of at least 5.5%; and
 - (e) passing the coated web through two extended-nip calenders, with each side of paper facing a heated roll and treated with one of said calender nips; whereby each calendaring nip is formed by a calender roll having a surface temperature of at least 422 K (300° F) and a backing shoe nip having a width of at least 30 mm, the nip providing loading of at least 178.6 kg per cm (1000 pounds per linear inch (pli)) and whereby the calendered paper has a caliper preservation greater than 75%, wherein the coating comprises:
 - (i) hollow plastic pigment, in an amount of at least about 2% by weight of the total amount of pigment;
 - (ii) kaolin pigment in an amount of at least about 70% by weight of the total amount of pigment said kaolin pigment having a fine particle size distribution **characterized by** at least 85% of said particles are less than 2 μm (microns) and at least 50% of said particles are less than 0.5 μm (microns) and a platy morphology **characterized** as both fine and coarse particles having a shape factor greater than 15, preferably 20-27;
 - (iii) titanium dioxide in an amount of at least about 2% by weight of the total amount of pigment;
 - (iv) calcined kaolin in an amount of at least 5% by weight of the total amount of pigment;
 - (v) synthetic latex in a concentration of at least about 12 or more parts by weight of the total amount of pigment;
 - (vi) synthetic thickener in a concentration of at least about 0.05 or more parts by weight of the total amount of pigment and wherein the finished coated paper has a basis weight of 0.0415 to 0.05615 kg/m² (28 to 38 pounds per 3300 square feet), exhibits a 75° TAPPI gloss of 35% or above, has a caliper of at least 54.61 μm (2.15 mils), gives a 17-27% higher caliper, has up to 22% bulk improvement relative to a supercalendered 0.0444 kg/m² (30 pounds/3300 square feet) LWC, and has improved brightness, opacity and printing gloss.
9. A coated paper sheet comprising :
 - a base paper formed from a fiber furnish wherein the fiber furnish comprising a mixture of mechanical pulp and chemical pulp; and
 - a coating having a weight of at least 0.00293 kg/m² (2.0 pounds per 3300 square feet) per side onto each

surface of the base paper, the coating comprising one or more pigments or clays and one or more binders, at least one of the pigments is a platy kaolin pigment having a fine particle size distribution **characterized in that** at least 85% of said particles are less than 2 μm (microns) and at least 50% of said particles are less than 0.5 μm (microns) based upon particle counting using a Sedigraph particle size analyzer and having a platy morphology **characterized** as both fine and coarse particles having a shape factor greater than 15.

10. A coated paper sheet as in claim 9 wherein the coating comprising:

- (i) hollow plastic pigment, in an amount of at least about 2% by weight of the total amount of pigment;
- (ii) kaolin pigment in an amount of at least about 70% by weight of the total amount of pigment, said kaolin pigment having a fine particle size distribution **characterized by** at least 85% of said particles are less than 2 μm (microns) and at least 50% of said particles are less than 0.5 μm (microns), and a platy morphology **characterized** as both fine and coarse particles having a shape factor greater than 15, preferably 20-27;
- (iii) titanium dioxide in an amount of at least about 2% by weight of the total amount of pigment;
- (iv) calcined kaolin in an amount of at least 5% by weight of the total amount of pigment;
- (v) synthetic latex in a concentration of at least about 12 or more parts by weight of the total amount of pigment;
- (vi) synthetic thickener in a concentration of at least about 0.05 or more parts by weight of the total amount of pigment; and wherein the finished coated paper has a basis weight of 0.0415 to 0.05615 kg/m^2 (28 to 38 pounds per 3300 square feet), exhibits a 75° TAPPI gloss of 35% or above, has a caliper of at least 54,61 μm (2.15 mils) gives a 17-27% higher caliper, has up to 22% bulk improvement relative to a supercalendered 0,0444 kg/m^2 (30 pounds/3300 square feet) LWC, and has improved brightness, opacity and printing gloss.

Patentansprüche

1. Verfahren zum Herstellen eines LWC-Papiers mit hohem spezifischen Volumen, umfassend die Schritte:

- (a) Erzeugen eines Faserstoffs, umfassend mechanische Pulpe und chemische Pulpe;
- (b) Bilden einer Papierbahn aus dem Faserstoff;
- (c) Entfernen von Wasser von der Bahn;
- (d) Aufbringen einer Beschichtung mit einem Gewicht von mindestens 0,00293 kg/m^2 (2,0 Pfund pro 3300 Quadratfuß) pro Seite auf jede Oberfläche der Bahn, um eine beschichtete Bahn mit einem Feuchtigkeitsgehalt von mehr als 5,5 % und einer Dicke von mehr als 66,04 μm (2,6 mils) zu bilden;
- (e) Laufenlassen der beschichteten Bahn durch zwei Breitspalt-Kalander, wobei jede Seite des Papiers einer erwärmten Walze gegenüber liegt und mit einer der Kalanderspalten behandelt wird, und

wobei jede Kalandrier-Spalte gebildet ist durch eine Kalandrierwalze mit einer Oberflächentemperatur von mindestens 422K (300°F) und einem Stützsuh mit einer Breite von mindestens 30 mm, wobei die Spalte eine Beladung von mindestens 178,6 kg/cm (1000 Pfund pro linearem Inch) bereitstellt, und wodurch das kalandrierte Papier eine Dickenerhaltung von mehr als 75% aufweist.

2. Verfahren nach Anspruch 1, wobei die Beschichtung ein flaches Kaolin als ein Pigment umfasst.

3. Verfahren nach Anspruch 2, wobei das Kaolinpigment eine Größenverteilung der feinen Teilchen besitzt, die **dadurch gekennzeichnet ist, dass** mindestens 85% der Teilchen kleiner sind als 2 μm (Mikron) und mindestens 50% der Teilchen kleiner sind als 0,5 μm (Mikron), basierend auf einer Teilchenzählung unter Verwenden eines Sedigraph-Teilchengrößenanalysators.

4. Verfahren nach Anspruch 2, wobei das Kaolinpigment eine flache Morphologie besitzt, **dadurch gekennzeichnet, dass** sowohl feine als auch grobe Teilchen einen Formfaktor von größer als 15 besitzen.

5. Verfahren nach Anspruch 2, wobei das Kaolinpigment eine flache Morphologie besitzt, **gekennzeichnet dadurch, dass** sowohl feine als auch grobe Teilchen einen Formfaktor von ungefähr 20 bis 27 besitzen.

6. Verfahren nach Anspruch 1, wobei die Beschichtung umfasst ein hohles Plastikpigment; ein Kaolinpigment; einen kalzinierten Kaolinton; ein Titandioxidpigment; ein synthetisches Latexbindemittel; und ein synthetisches Verdickungsmittel, oder ein Co-Bindemittel, einschließlich aus auf Carboxymethylcellulose oder Acrylsäure basierenden

oder assoziativ basierenden Verdickungsmitteln.

7. Verfahren nach Anspruch 1, wobei der Kalandrierer ein Schuhspalt-Kalandrierer ist, wobei die Schuhspalten-Breite im Bereich von ungefähr 40 mm bis ungefähr 80 mm liegt, und die Kalandrier-Temperatur mindestens 422K (300°F) beträgt und die Spaltenbelastung bei 303,6- 428,6 kg pro cm (1700-2400 pli) liegt.

8. Verfahren zum Herstellen eines Offset-LWC-Papiers mit extra hohem spezifischen Volumen, umfassend

- (a) Erzeugen eines Faserstoffs, umfassend mindestens 40% mechanische Pulpe;
- (b) Bilden einer Papierbahn aus dem Faserstoff;
- (c) Entfernen von Wasser aus der Bahn;
- (d) Aufbringen einer Beschichtung unter Verwenden einer Rakelstreichmaschine an einem Beschichter bei Beschichtungsgewichten von mindestens 0,00293 kg/m² (2,0 Pfund pro 3300 Quadratfuß) pro Seite auf jede Oberfläche der Bahn, um eine beschichtete Bahn mit einem Feuchtigkeitsgehalt von mindestens 5,5% zu bilden; und
- (e) Laufenlassen der beschichteten Bahn durch zwei Breitspalt-Kalandrierer, wobei jede Seite des Papiers einer erwärmten Rolle gegenüberliegt und mit einer der Kalandrier-Spalten behandelt wird; wobei jede Kalandrier-Spalte durch eine Kalandrierwalze gebildet wird mit einer Oberflächentemperatur von mindestens 422K (300°F) und einem Stützsuh-Spalt mit einer Breite von mindestens 30 mm, wobei der Spalt eine Belastung von mindestens 178,6 kg pro cm (1000 Pfund pro linearem Inch (pli)) bereitstellt und wodurch das kalandrierte Papier eine Dickenerhaltung von mehr als 75% aufweist, wobei die Beschichtung umfasst:

- (i) ein hohles Plastikpigment, in einer Menge von mindestens ungefähr 2 Gewichtsprozent der Gesamtmenge des Pigments;
- (ii) Kaolinpigment in einer Menge von mindestens ungefähr 70 Gewichtsprozent der gesamten Menge des Pigmentes, wobei das Kaolinpigment eine Größenverteilung der feinen Teilchen besitzt, **gekennzeichnet dadurch, dass** mindestens 85% der Teilchen kleiner sind als 2 µm (Mikron) und mindestens 50% der Teilchen kleiner sind als 0,5 µm (Mikron), und eine flache Morphologie besitzt, **gekennzeichnet dadurch, dass** sowohl feine als auch grobe Teilchen einen Formfaktor von mehr als 15, bevorzugt 20 bis 27 besitzen;
- (iii) Titandioxid in einer Menge von mindestens ungefähr 2 Gewichtsprozent der gesamten Menge des Pigments;
- (iv) kalziniertes Kaolin in einer Menge von mindestens 5 Gewichtsprozent der gesamten Menge des Pigments;
- (v) synthetisches Latex in einer Konzentration von mindestens ungefähr 12 oder mehr Gewichtsteilen der gesamten Menge des Pigments;
- (vi) ein synthetisches Verdickungsmittel in einer Konzentration von mindestens ungefähr 0,05 oder mehr Gewichtsteilen der gesamten Menge des Pigments, und wobei das fertige beschichtete Papier ein Basisgewicht von 0,0415 bis 0,05615 kg/m² (28 bis 38 Pfund pro 33 Quadratfuß) besitzt, einen 75°-TAPPI-Glanz von 35% oder darüber zeigt, eine Dicke von mindestens 54,61 µm (2,15 mils) besitzt, eine 17-27% höhere Dicke ergibt, eine Verbesserung bis zu 22% spezifischem Volumen relativ zu einem superkalandrierten 0,0444 kg/m² (30 Pfund/3300 Quadratfuß) LWC besitzt, und einen/eine verbesserten Weißgehalt, Opazität und Druckglanz besitzt.

9. Beschichtetes Papierblatt umfassend:

ein Basispapier, gebildet aus einem Faserstoff, wobei der Faserstoff eine Mischung von mechanischer Pulpe und chemischer Pulpe umfasst; und
 einer Beschichtung mit einem Gewicht von mindestens 0,00293 kg/m² (2,0 Pfund pro 3300 Quadratfuß) pro Seite auf jeder Oberfläche des Basispapiers, wobei die Beschichtung umfasst
 eines oder mehrere Pigmente oder Töne oder einen oder mehrere Bindemittel, wobei mindestens eines der Pigmente ein flaches Kaolinpigment mit einer Größenverteilung der feinen Teilchen besitzt, die **dadurch gekennzeichnet ist, dass** mindestens 85% der Teilchen kleiner sind als 2 µm (Mikron) und mindestens 50% der Teilchen kleiner sind als 0,5 µm (Mikron), basierend auf einer Teilchenzählung unter Verwenden eines Sedi-graph-Teilchengrößenanalysators, und mit einer flachen Morphologie, **gekennzeichnet dadurch, dass** sowohl die feinen als auch die groben Teilchen einen Formfaktor von größer als 15 besitzen.

10. Beschichtetes Papierblatt nach Anspruch 9, wobei die Beschichtung umfasst:

- (i) ein hohles Plastikpigment, in einer Menge von mindestens ungefähr 2 Gewichtsprozent der Gesamtmenge des Pigments;
 - (ii) Kaolinpigment in einer Menge von mindestens ungefähr 70 Gewichtsprozent der gesamten Menge des Pigmentes, wobei das Kaolinpigment eine Größenverteilung der feinen Teilchen besitzt, **gekennzeichnet dadurch, dass** mindestens 85% der Teilchen kleiner sind als 2 μm (Mikron) und das mindestens 50% der Teilchen kleiner sind als 0,5 μm (Mikron) und eine flache Morphologie besitzt, **gekennzeichnet dadurch, dass** sowohl feine als auch grobe Teilchen einen Formfaktor von größer als 15, bevorzugt 20 bis 27 besitzen;
 - (iii) Titandioxid in einer Menge von mindestens ungefähr 2 Gewichtsprozent der Gesamtmenge des Pigments;
 - (iv) kalziniertes Kaolin in einer Menge von mindestens 5 Gewichtsprozent der Gesamtmenge des Pigments;
 - (v) synthetisches Latex in einer Konzentration von mindestens ungefähr 12 oder mehr Gewichtsteilen der Gesamtmenge des Pigments;
 - (vi) ein synthetisches Verdickungsmittel in einer Konzentration von mindestens ungefähr 0,05 oder mehr Gewichtsteilen der Gesamtmenge des Pigmentes;
- und wobei das fertige beschichtete Papier ein Basisgewicht von 0,0415 bis 0,05615 kg/m² (28 bis 38 Pfund pro 3300 Quadratfuß) besitzt, einen 75° TAPPI-Glanz von 35% oder mehr, eine Dicke von mindestens 54,61 μm (2,15 mils) besitzt, eine um 17 bis 27% höhere Dicke ergibt, bis zu 22% Verbesserung des spezifischen Volumens relativ zu einem superkalandrierten 0,0444 kg/m² (30 Pfund/3300 Quadratfuß) LWC besitzt, und einen/eine verbesserten Weißglanz, Opazität und Druckglanz besitzt.

Revendications

1. Processus de fabrication d'un papier LWC très bouffant, comprenant les étapes suivantes :

- (a) création d'une composition fibreuse comprenant une pâte mécanique et une pâte chimique ;
- (b) mise en forme d'une bande continue de papier à partir de la composition fibreuse ;
- (c) évacuation de l'eau hors de ladite bande continue;
- (d) application d'une couche présentant un poids d'au moins 0,00293 kg/m² (2,0 livres par 3300 pieds carrés) par côté, sur chaque surface de ladite bande continue afin de former une bande continue couchée présentant une teneur en eau supérieure à 5,5 % et une épaisseur supérieure à 66,04 μm (2,6 mils) ;
- (e) passage de la bande continue couchée à travers deux calandres à pince allongée, chacun des côtés du papier faisant face à un rouleau chauffé et étant traité par l'une desdites pinces de calandre, et dans lequel chaque pince de calandrage est constituée d'un rouleau de calandre présentant une température de surface d'au moins 422 K (300°F) et un patin de support présentant une largeur d'au moins 30 mm, la pince fournissant une charge d'au moins 178,6 kg par cm (1000 livres par pouce linéaire), et dans lequel le papier calandré présente un coefficient de préservation d'épaisseur supérieur à 75 %.

2. Processus selon la revendication 1, dans lequel la couche comprend un kaolin lamellaire en tant que pigment.

3. Processus selon la revendication 2, dans lequel ledit pigment de kaolin présente une composition granulométrique de particule fine **caractérisée en ce qu'**au moins 85 % desdites particules sont inférieures à 2 μm (microns) et au moins 50 % desdites particules sont inférieures à 0,5 μm (microns) selon un comptage de particules effectué à l'aide d'un analyseur granulométrique sédigraphie.

4. Processus selon la revendication 2, dans lequel le pigment de kaolin présente une morphologie lamellaire **caractérisée en ce qu'**aussi bien les particules fines que grosses présentent un facteur de forme supérieur à 15.

5. Processus selon la revendication 2, dans lequel le pigment de kaolin présente une morphologie lamellaire **caractérisée en ce qu'**aussi bien les particules fines que grosses présentent un facteur de forme compris entre 20 et 27.

6. Processus selon la revendication 1, dans lequel ladite couche comprend un pigment plastique creux ; un pigment de kaolin ; une argile kaolinique cuite ; un pigment de dioxyde de titane ; un liant de latex synthétique ; et un agent épaississant synthétique ou un co-liant comprenant des agents épaississants à base de carboxyméthylcellulose ou d'acide acrylique ou des deux.

7. Processus selon la revendication 1, dans lequel la calandre est une calandre à pince à patin, la largeur de ladite

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pince à patin étant comprise entre environ 40 mm et environ 80 mm, et la température de calandrage est d'au moins 422 K (300°F) et la charge de la zone de pincement comprise entre 303,6 et 478,6 kg par cm (1700-2400 livres par pouce linéaire).

5 8. Processus de fabrication d'un papier LWC, offset et surbouffant, comprenant :

- (a) création d'une composition fibreuse comprenant au moins 40 % de pâte mécanique ;
- (b) mise en forme d'une bande continue de papier à partir de la composition fibreuse ;
- (c) évacuation de l'eau hors de ladite bande continue ;
- 10 (d) application d'une couche à l'aide d'une coucheuse à lame à des poids de couche d'au moins 0,00293 kg/m² (2,0 livres par 3300 pieds carrés) par côté, sur chaque surface de ladite bande continue afin de former une bande continue couchée présentant une teneur en eau d'au moins 5,5 % ; et
- (e) passage de la bande continue couchée à travers deux calandres à pince allongée, chacun des côtés du papier faisant face à un rouleau chauffé et étant traité par l'une desdites pinces de calandre ; dans lequel chaque
- 15 pince de calandrage est constituée d'un rouleau de calandre présentant une température de surface d'au moins 422 K (300°F) et une pince à patin de support présentant une largeur d'au moins 30 mm, la pince fournissant une charge d'au moins 178,6 kg par cm (1000 livres par pouce linéaire), et dans lequel le papier calandré présente un coefficient de préservation d'épaisseur supérieur à 75 %, dans lequel la couche comprend :
- 20 (i) un pigment plastique creux, dans une quantité représentant au moins environ 2 % en poids de la quantité totale de pigment ;
- (ii) un pigment de kaolin dans une quantité représentant au moins environ 70 % en poids de la quantité totale de pigment, ledit pigment de kaolin présentant une composition granulométrique de particule fine
- 25 **caractérisée en ce qu'**au moins 85 % desdites particules sont inférieures à 2 µm (microns) et au moins 50 % desdites particules sont inférieures à 0,5 µm (microns), et une morphologie lamellaire **caractérisée en ce qu'**aussi bien les particules fines que grosses présentent un facteur de forme supérieur à 15, de préférence compris entre 20 et 27 ;
- (iii) du dioxyde de titane dans une quantité représentant au moins environ 2 % en poids de la quantité totale de pigment ;
- 30 (iv) du kaolin cuit dans une quantité représentant au moins 5 % en poids de la quantité totale de pigment ;
- (v) du latex synthétique dans une concentration représentant au moins environ 12 parts en poids ou plus de la quantité totale de pigment ;
- (vi) un agent épaississant dans une concentration représentant au moins environ 0,05 parts en poids ou plus de la quantité totale de pigment ; et dans lequel le papier couché fini présente un grammage de 0,0415
- 35 à 0,05615 kg/m² (28 à 38 livres par 3300 pieds carrés), une brillance de TAPPI à 75° de 35 % ou plus, une épaisseur d'au moins 54,61 µm (2,15 mils), un coefficient d'épaisseur de 17 à 27 % plus important, jusqu'à 22 % d'amélioration du bouffant par rapport à un papier LWC satiné de 0,0444 kg/m² (30 livres/3300 pieds carrés) et un degré de blancheur, une opacité et une brillance à l'impression renforcés.

40 9. Feuille de papier couché, comprenant :

- un papier support formé à partir d'une composition fibreuse, dans lequel la composition fibreuse comprend un mélange de pâte mécanique et de pâte chimique ; et
- une couche présentant un poids d'au moins 0,00293 kg/m² (2,0 livres par 3300 pieds carrés) par côté, sur
- 45 chaque surface du papier support, la couche comprenant :

- un ou plusieurs pigments ou argiles et un ou plusieurs liants, au moins l'un des pigments étant un pigment de kaolin lamellaire présentant une composition granulométrique de particule fine **caractérisée en ce qu'**au moins 85 % desdites particules sont inférieures à 2 µm (microns) et au moins 50 % desdites particules
- 50 sont inférieures à 0,5 µm (microns) selon un comptage de particules effectué à l'aide d'un analyseur granulométrique sédigraphie, et une morphologie lamellaire **caractérisée en ce qu'**aussi bien les particules fines que grosses présentent un facteur de forme supérieur à 15.

10. Feuille de papier couché selon la revendication 9, dans laquelle la couche comprend :

- (i) un pigment plastique creux, dans une quantité représentant au moins environ 2 % en poids de la quantité totale de pigment ;
- (ii) un pigment de kaolin dans une quantité représentant au moins environ 70 % en poids de la quantité totale

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de pigment, ledit pigment de kaolin présentant une composition granulométrique de particule fine **caractérisée en ce qu'**au moins 85 % desdites particules sont inférieures à 2 μm (microns) et au moins 50 % desdites particules sont inférieures à 0,5 μm (microns), et une morphologie lamellaire **caractérisée en ce qu'**aussi bien les particules fines que grosses présentent un facteur de forme supérieur à 15, de préférence compris entre 20 et 27 ;

(iii) du dioxyde de titane dans une quantité représentant au moins environ 2 % en poids de la quantité totale de pigment ;

(iv) du kaolin cuit dans une quantité représentant au moins 5 % en poids de la quantité totale de pigment ;

(v) du latex synthétique dans une concentration représentant au moins environ 12 parts en poids ou plus de la quantité totale de pigment ;

(vi) un agent épaississant dans une concentration représentant au moins environ 0,05 parts en poids ou plus de la quantité totale de pigment ; et dans lequel le papier couché fini présente un grammage de 0,0415 à 0,05615 kg/m^2 (28 à 38 livres par 3300 pieds carrés), une brillance de TAPPI à 75° de 35 % ou plus, une épaisseur d'au moins 54,61 μm (2,15 mils), un coefficient d'épaisseur de 17 à 27 % plus important, jusqu'à 22 % d'amélioration du bouffant par rapport à un papier LWC satiné de 0,0444 kg/m^2 (30 livres/3300 pieds carrés) et un degré de blancheur, une opacité et une brillance à l'impression renforcés.

Figure 1 - Caliper

(The yellow bars represent 13.61 kg(30 lbs) commercial LWC; red bars represent averaged industry LWC data with basis weight ranged from 14.51 - 18.14 kg (32-40 lbs), green bars are 13.61 kg (30lbs) SNCLWC)

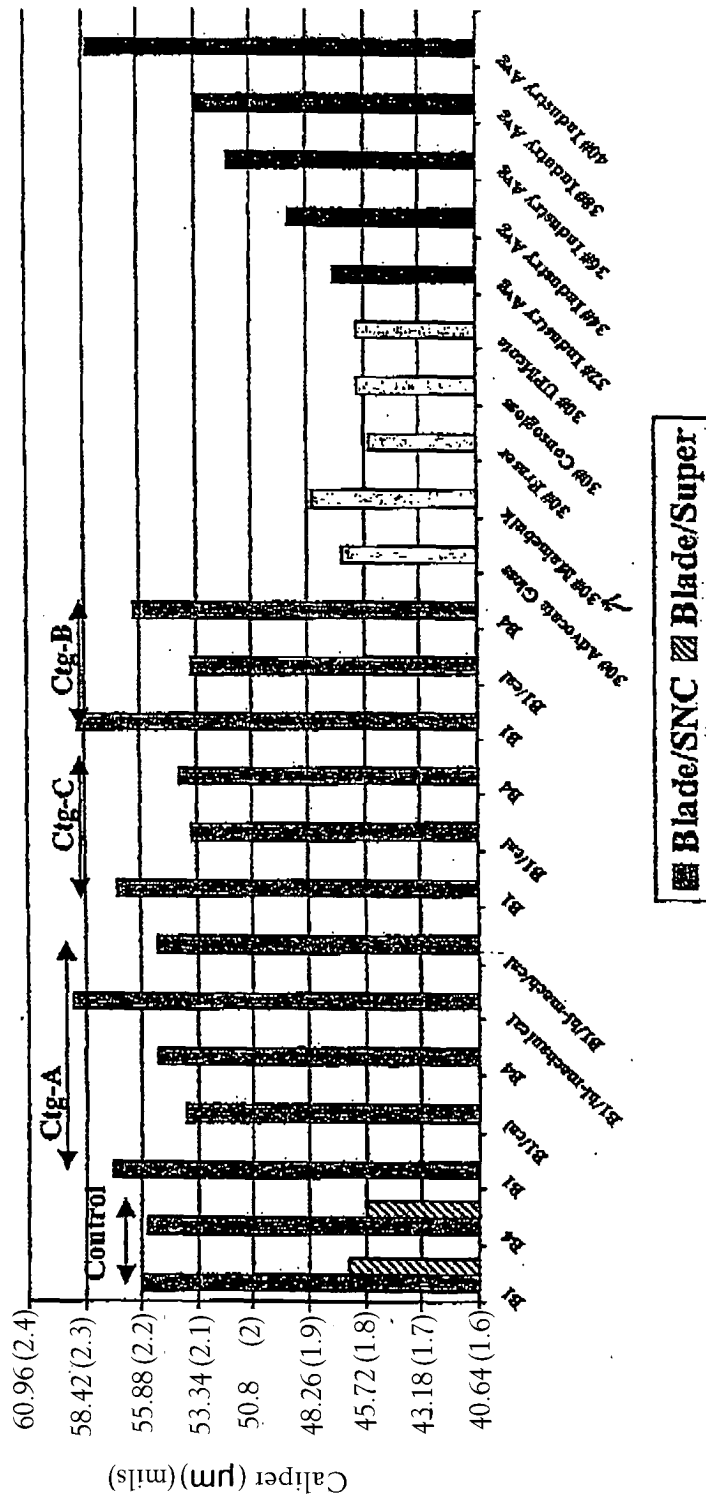


Figure 3: Opacity

(The yellow bars represent 13.61 kg(30 lbs) commercial LWC; red bars represent averaged industry LWC data with basis weight ranged from 14.51 - 18.14 kg (32-40 lbs), green bars are 13.61 kg (30lbs) SNCLWC)

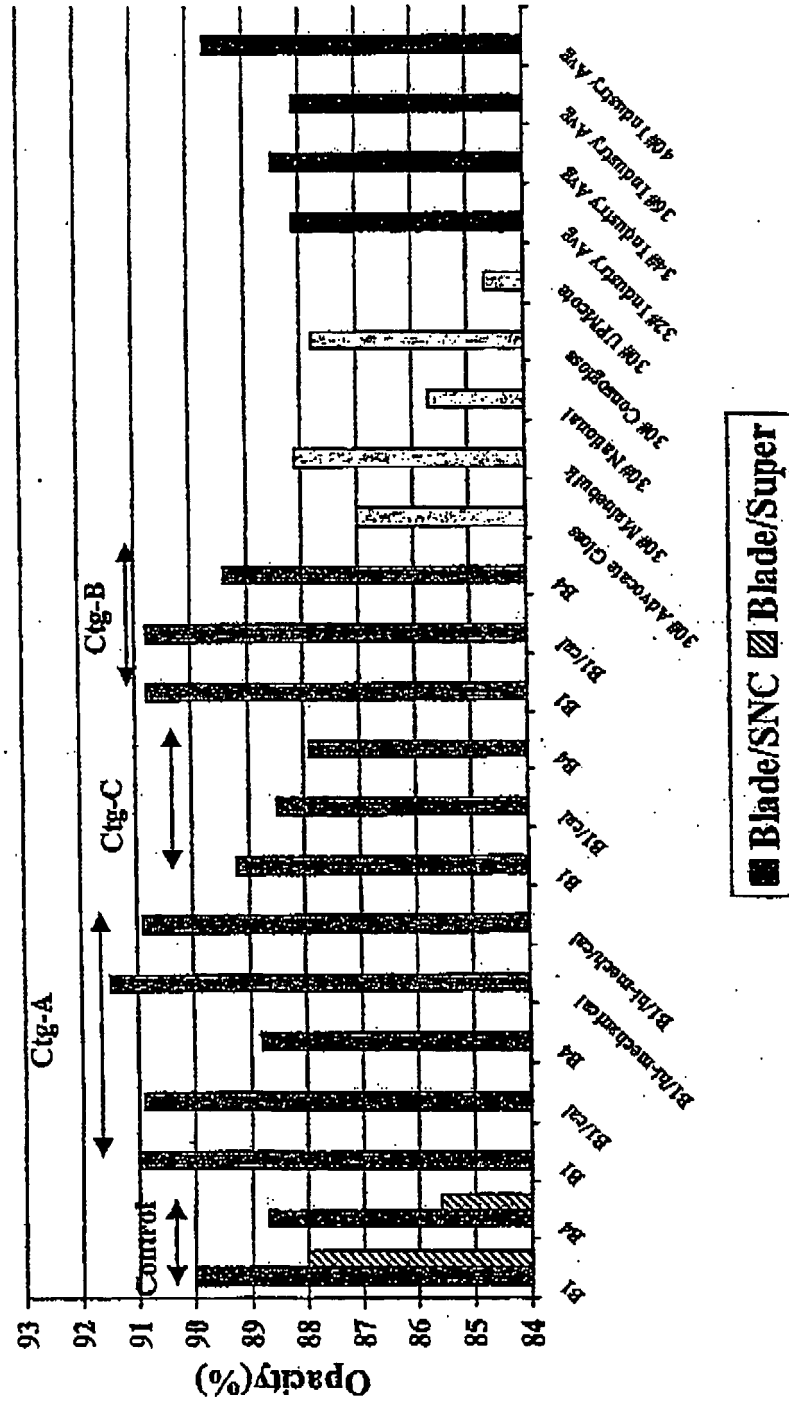


Figure 4: Sheet Gloss

(The yellow bars represent 13.61 kg(30 lbs) commercial LWC; red bars represent averaged industry LWC data with basis weight ranged from 14.51 - 18.14 kg (32-40 lbs), green bars are 13.61 kg (30lbs) SNC LWC)

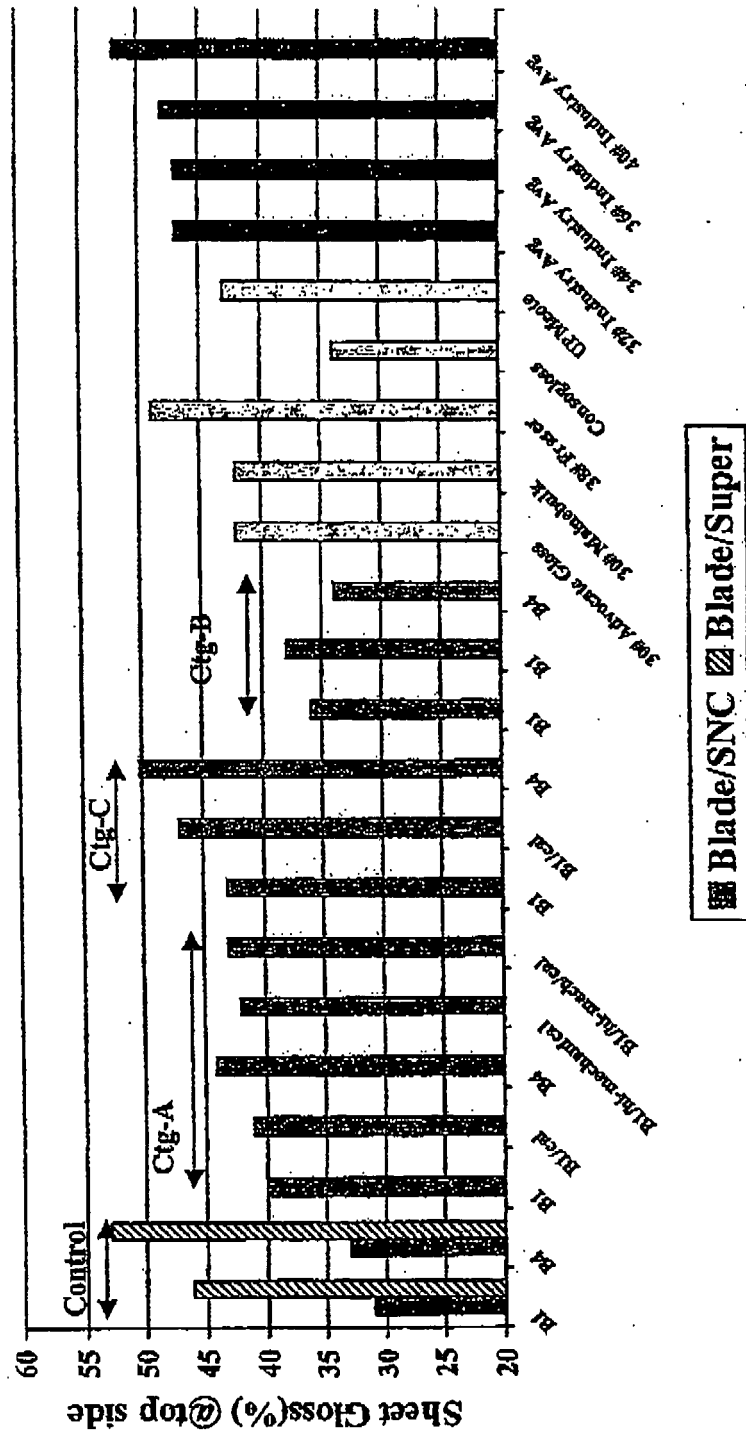


Figure 5: PPS

(The yellow bars represent 13.61 kg(30 lbs) commercial LWC; red bars represent averaged industry LWC data with basis weight ranged from 14.51 - 18.14 kg (32-40 lbs), green bars are 13.61 kg (30lbs) SNC LWC)

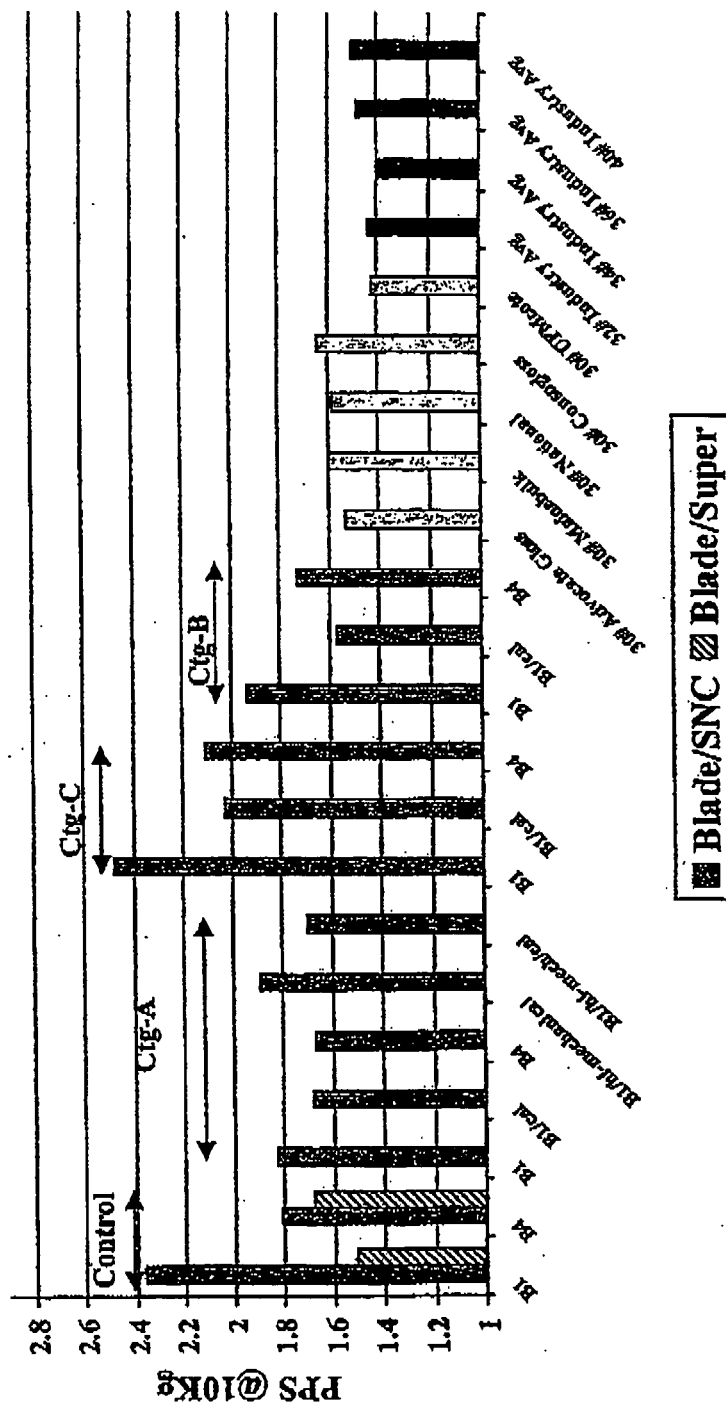
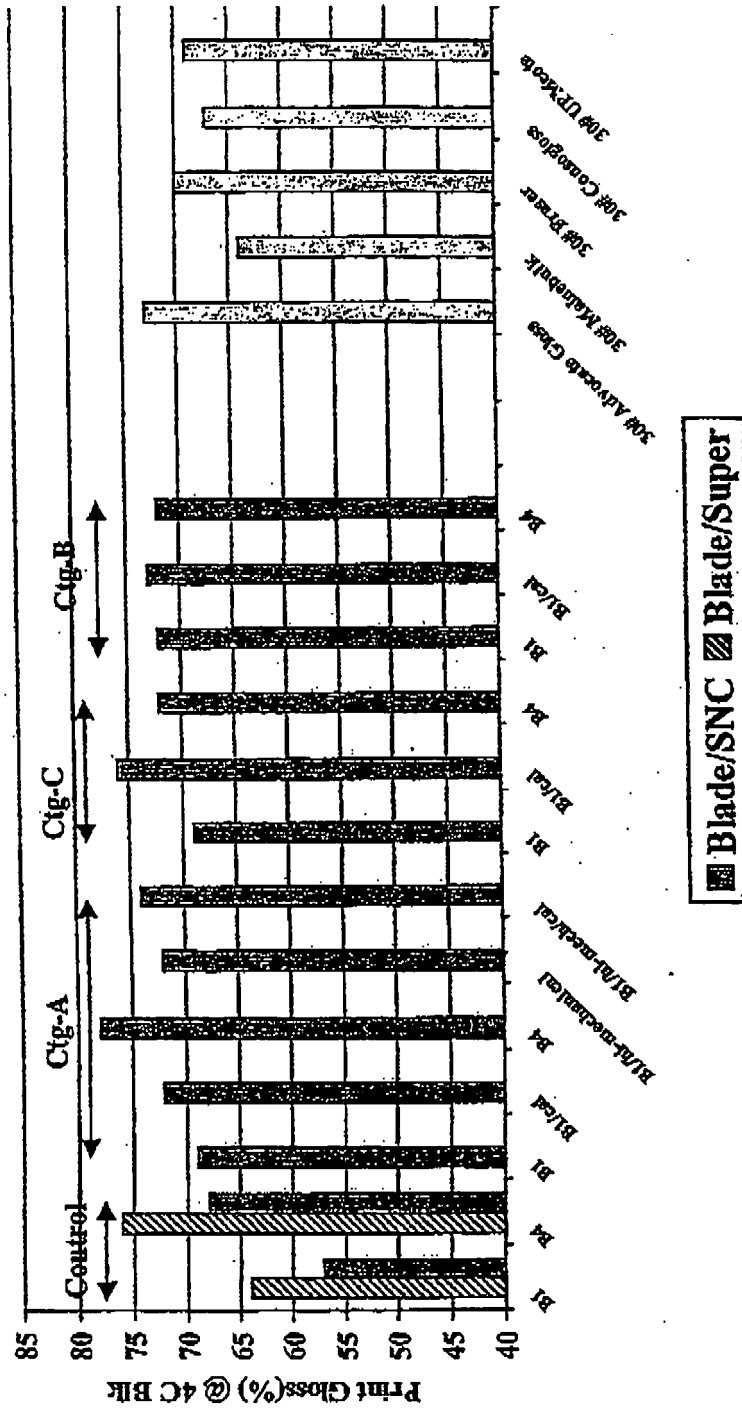


Figure 6: Print Gloss

(The yellow bars represent 13.61 kg(30 lbs) commercial LWC; green bars are 13.61 kg (30lbs) SNCLWC)



REFERENCES CITED IN THE DESCRIPTION

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