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54 Paper coating.

57 There is disclosed a method of gravure printing comprising printing onto paper coated with a composition including a pigment which consists predominantly of a water-swellable smectite-type clay, the coat weight being no greater than 5 gm⁻².

Also disclosed is a printing paper suitable for gravure printing and a method of preparing such a printing paper.

Description**PAPER COATING**

This invention relates to coated paper suitable for printing by a gravure, particularly a rotogravure process of an offset lithography process, to a method of preparing the coated paper and to a method of printing using such a coated paper.

BACKGROUND OF THE INVENTION

Gravure printing is a form of intaglio printing, i.e. printing which uses a plate or cylinder into the surface of which the subject matter to be printed is etched or engraved. A liberal film of fluid printing ink is applied to the whole printing surface and the surface is then wiped, for example by a doctor blade, in order to remove all the ink from the unindented parts of the surface leaving ink only in the indentations or cells. Paper in a continuous web or in separate sheets is then pressed into contact with the inked surface in order to receive an impression of the subject matter.

Gravure printing paper, is typically coated with a pigment consisting predominantly of calcium carbonate or a layer lattice silicate such as kaolin clay. Neither calcium carbonate nor kaolin clays swell appreciably in water and aqueous coating compositions comprising such pigments may contain a relatively high proportion of the pigment without becoming unworkable due to high viscosity. A paper coated with such a pigment will typically have a coat weight of at least 5 gm^{-2} and normally in the range of from 5 to 15 gm^{-2} . It has previously been considered impractical to use a smectite-type clay as the primary pigment in paper-coating owing to its tendency to swell in water and to viscosify the coating suspension, even at relatively low solids contents. Moreover, many smectite-type clays do not possess the desirable degree of whiteness necessary to be usable as paper coating pigments.

In offset lithography printing an inked image is first printed on a rubber sleeve or "blanket" surrounding a metal cylinder and then transferred to paper. An offset lithography machine generally has three main rolls, a plate roll round which is fastened a metal printing plate, a blanket roll and an impression roll which biases the paper in contact with the blanket roll. The printing plate first comes into contact with a series of moistening rollers which cause the non-printing areas of the plate to retain water. The printing plate then passes beneath inking rollers which apply ink to the areas of the plate to be printed. The water-retaining, non-printing areas reject the greasy printing ink.

In gravure printing if the printing paper has small areas which are not in contact with the edges of the recessed cells of the printing plate, ink will not be drawn out of those cells on to the paper and the result will be "missing data" or "speckle". In order to overcome this problem the paper must either be perfectly smooth and level ("mirror smooth") or its surface must be compressible to enable it to conform exactly to the surface of the printing plate.

In offset lithography printing the desirable properties for a suitable paper are:

1. Good dimensional stability when wet to avoid displacement of the print image between the application of different colours in a multi-colour process.

2. resistance to "pick", i.e. the removal of part of the coating under the action of forces operating in the printing process. This is important because a) the separation forces between the paper surface and the offset blanket are high, b) the coated paper surface is weakened by moisture, c) very tacky printing inks are used.

3. Resistance to "linking", i.e. the deposition of paper fibres or dislodged coating pigment particles on the offset blanket.

4. Good ink absorption which enables the ink to dry and set quickly to avoid unwanted set-off of the ink.

By contrast with gravure printing papers, the smoothness and gloss of offset lithography papers has little effect on the efficiency of printing ink transfer although the visual appearance of a print image on a smooth glossy paper will be very different from that on a matt paper. Also it is not necessary for an offset lithography paper to be compressible because the offset blanket itself is so deformable.

It has been proposed in EP-0192252 to treat a cellulosic sheet material, especially paper, in order to improve the hold-out of printing ink containing an organic solvent, by incorporating in the cellulosic fibre pulp from which the sheet material is prepared or by applying to the surface of the sheet material an organophilic complex of a smectite clay having a cation exchange capacity of at least 50 milliequivalents/100 g and an organic group derived from an onium compound. The organophilic cation-modified smectite clay forms a barrier film by reacting with the solvent in the printing ink.

US-4549930 describes an un-coated paper, suitable for rotogravure printing with water-immiscible inks containing an organic solvent, in which the cellulosic fibres of the paper are partially or totally enveloped by a clay hydrogel, the clay being hydratable, colloidal and film-forming.

EP-0046416 discloses an ink jet recording sheet comprising a paper support which may be applied on at least one surface with a composition comprising polyvinylpyrrolidone, a vinylpyrrolidone-vinyl acetate copolymer or a mixture thereof, and a white filler. Although a number of so-called "white-fillers" are suggested, the only ones exemplified are talc and calcium carbonate.

GB-2039789 discloses an electrostatic imaging sheet, one surface of which is electrically conductive and the other side of which either has a continuous dielectric layer comprising a mixture of a smectite clay and an

electrically insulating polymer or has a layer of a smectite clay which forms a barrier between the electrically conductive layer and a dielectric layer of an insulating polymer. It is evident from the examples that the smectite clay forms only a very small proportion of the total pigment in the coating applied to the sheet.

GB-933928 discloses a method of making copies from hectographic printing master sheets. The copy sheets, which are moistened with a solvent before printing, are coated, inter alia, with a composition comprising a bentonite and a binder.

SUMMARY OF THE INVENTION

According to a first aspect of the present invention there is provided a method of gravure printing comprising printing onto paper coated with a composition including a pigment which consists predominantly of a water-swellable smectite-type clay, the coat weight being no greater than 5 gm^{-2} .

According to a second aspect of the present invention there is provided a gravure printing paper provided with a coating including a pigment consisting predominantly of a water-swellable smectite-type clay, the coat weight being no greater than 5 gm^{-2} .

The smectite clay may be bentonite, montmorillonite, hectorite, saponite or fullers earth, but especially preferred is a natural bentonite which has, or has been treated to have, predominantly sodium ions in its exchangeable cation sites.

Most preferably, the coat weight is no greater than 1 gm^{-2} and is typically of the order of 0.5 gm^{-2} .

As mentioned above, the pigment consists predominantly of the smectite-type clay. Preferably, the pigment comprises at least 70% by weight, more preferably 80% by weight and most preferably more than 90% by weight of the smectite-type clay. In many cases, the pigment is wholly smectite-type clay. Any secondary pigment present may be of the conventional type, for instance kaolin clay or calcium carbonate.

The coating may also include an adhesive which assists in binding the clay particles to each other and to the sheet member of the paper.

The adhesive may be any conventional adhesive used in paper coating, for example, starch, latex, casein, gelatine or other synthetic resin latexes. Particularly advantageous results have been obtained when the adhesive is starch or latex.

According to a third aspect of the present invention, there is provided a method of preparing a printing paper which comprises the step of applying to the surface of a cellulosic sheet material an aqueous suspension comprising up to 20% by weight of a pigment which consists predominantly of a water-swellable smectite-type clay, the suspension being applied in an amount sufficient to provide a coating on the sheet material having a coat weight no greater than 5 gm^{-2} .

Preferably, the aqueous suspension will contain less than 10% by weight of the pigment.

In carrying out the method of gravure printing according to the present invention the aqueous suspension of the smectite clay may also contain an adhesive to assist in bonding the clay to the fibres of the cellulosic sheet; but this is not essential as it is found that adequate adhesion of the clay to the cellulosic fibres is achieved in the absence of an adhesive. When an adhesive is used it is found that for a paper intended for rotogravure printing a starch or a latex adhesive is preferred and especially an acrylic copolymer latex. However, any conventional adhesive is operable. Generally the quantity of adhesive used will be in the range from 1 to 300 parts by weight of dry polymer to 100 parts by weight of dry smectite clay.

EMBODIMENTS OF THE INVENTION

The invention is further illustrated by the following Examples.

EXAMPLE 1

Hand-coated paper sheets were prepared by coating sheets of a Scandinavian supercalendered magazine paper of substance weight 60 gm^{-2} by means of a wire-wound bar which was wound with a wire of diameter 15 microns and thus adapted to provide a coat weight in the range from 0.25 gm^{-2} to 0.5 gm^{-2} .

The hand-coated sheets were coated with one of the following two coating compositions:-

1. A suspension of 5% by weight of an organoclay in toluene. the organoclay was prepared by reacting a refined Wyoming sodium bentonite with 105 meq/100 g of bentonite of a mixture of quaternary ammonium compounds consisting of 75 mol % of dimethyl di(hydrogenated tallow) ammonium chloride and 25 mol % of dimethyl benzyl (hydrogenated tallow) ammonium chloride.

2. A suspension of 2.5% by weight of the same refined Wyoming bentonite in water. Samples of the hand-coated sheets were printed with test rotogravure prints on a Winstone proof press using the technique described in the article "Realistic paper tests for various printing processes" by A Swan, published in "Printing Technology". Vol 13, No 1, April 1969, pages 9-22. A gravure printing cylinder was used with an area of deeply etched cells to give a solid black area and an area of less deeply etched cells to give a half tone area. The gloss of the solid black area on the tests prints was measured by the Tappi Standard Method No. T480 ts-65 and the print density of the solid black areas was determined according to the formula:-

Print density = $\log_{10} (1/\text{reflectance})$

Where the reflectance is the fraction of the incident light of wavelength 574 nm reflected back from the black area.

A further measurement of print density was performed on the reverse side of the paper in the region of the solid black area in order to determine the degree of "strike through" of the printing ink.

As a comparison the same test were performed on sheets of the un-coated magazine paper. The results obtained are set forth in Table 1 below:

TABLE 1

Coating composition	Coat weight (gm ⁻²)	Gloss of solid black area	Print Density solid black area	Density reverse of solid black area
None	0	26	1.34	0.18
Organoclay in toluene	0.5	54	1.61	0.14
Bentonite in water	0.25	46	1.58	0.14

The results show that the print gloss and print density results achieved with the coating composition according to the invention, namely bentonite in water, are very nearly as good as those obtained with a suspension of organoclay in toluene and the additional expense of the organoclay compared with the untreated bentonite and the inconvenience of using an organic solvent are avoided. The "strike through" is the same for both coating compositions.

EXAMPLE 2

Further samples of coated paper were prepared using a laboratory paper coating apparatus of the type described in British Patent Specification No. 1032536. Two different base papers were used namely.

1. A French offset printing wood free paper of substance weight 90 gm⁻².
2. A Scandinavian web supercalendered offset printing paper of substance weight 52 gm⁻². Each base paper was coated with a composition consisting of a suspension of 50% by weight of a Wyoming sodium bentonite in water and the printing tests described in Example 1 were performed on each sample of coated paper.

In addition the degree of "speckle" in the half tone area of each print was determined by estimating the percentage of gravure printing dots which were missing from the test print.

As a comparison the same tests were performed on un-coated samples of the two base papers. The results obtained are set forth in Table II below:-

TABLE II

	Gloss of solid black area	Print density solid black area	Density reverse of solid black area	% missing dots (half tone area)
Base paper 1 coated	62	1.79	0.14	11
Base paper 1 un-coated	53	1.59	0.13	12
Base paper 2 coated	69	1.89	0.17	2.3
Base paper 2 un-coated	60	1.71	0.18	2.6

EXAMPLE 3

A Scandinavian base paper of substance weight 57 gm⁻² was coated by means of laboratory coating machine of the type described in British Patent Specification No. 1032536 with paper coating compositions which consisted of suspensions containing varying quantities of Wyoming sodium bentonite in water. In addition two coating compositions were used which contained 9% by weight of the bentonite and 5% by weight and 10% by weight respectively of a paper coating adhesive which was a 50% by weight latex of an acrylic copolymer, each percentage by weight representing the percentage of dry copolymer based on the weight of dry bentonite.

The same printing tests as are described in Examples 1 and 2 above were performed on the coated samples. As a comparison the same tests were performed on un-coated samples of the same base paper and the results are set forth in Table III below:-

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TABLE III

	% by weight of bentonite	% by weight of adhesive	gloss of solid black area	Print density		% missing dots (half tone area)
				solid black area	reverse of solid black area	
Coated	3	0	62	1.86	0.11	2.6
"	6	0	67	1.93	0.12	3.0
"	9	0	69	1.94	0.12	2.8
"	9	5	70	2.04	0.12	3.0
"	9	10	70	2.03	0.13	2.8
"	12	0	73	2.06	0.12	2.8
"	15	0	76	2.15	0.12	3.2
Uncoated	0	0	50	1.71	0.13	2.5

EXAMPLE 4

A rotogravure printing base paper of substance weight 60 gm⁻² was coated by means of the laboratory coating apparatus used in examples 2 and 3 running at a speed of 400 m.min⁻¹ with compositions containing various proportions by weight of a European bentonite having sodium and calcium exchangeable cations, together with, in most cases, either a starch paper coating adhesive or an acrylic copolymer latex adhesive.

The rotogravure printing tests for the gloss of the solid black printed area and the print density of the solid black area were performed as described in Example 1 and the gloss of an un-printed area of each coated sample was measured by the TAPPI Standard Method No.T480ts-65.

The results obtained are set forth in Table IV below:

TABLE IV

Percentage by weight of bentonite	Percentage by weight of suspension of starch	aqueous latex	Gloss of unprinted paper	Gloss of solid black area	Print density solid black area
0	0	0	26	19	1.35
0	10	0	32	29	1.42
2	0	0	30	30	1.49
2	0	0.5	29	35	1.56
2	0	1.0	29	40	1.62
2	0	2.0	25	47	1.67
2.5	7.5	0	35	49	1.67
5.0	5.0	0	33	50	1.67
9	0	0	37	45	1.61

These results show that bentonite and either a starch adhesive or an acrylic copolymer latex exhibit a synergistic effect. The gloss and print density of the solid black printed area obtained with about 20% by weight of bentonite and a relatively small quantity of either starch or latex in the coating composition are approximately equivalent to the results which are obtained with a coating composition containing 9% by weight of bentonite alone.

EXAMPLE 5

A supercalendered newsprint paper of substance weight 39 gm^{-2} was coated by means of the laboratory paper coating apparatus used in Examples 2 and 3 running at a speed of 400 m min^{-1} with a composition consisting of a suspension of 5% by weight of a European bentonite having sodium and calcium exchangeable cations.

Samples of the coated paper were tested for offset lithography printing properties by means of an IGT Model AC2 printability tester. The paper samples were clipped to the moving sector of the instrument which was set to move at a constant velocity of 1 ms^{-1} . An aluminium alloy damping roll of face width 25 mm and a rubber covered printing roll of face width 20 mm were rotatably and removably mounted on spindles provided on the fixed part of the instrument with the damping roll contacting the surface of the paper sample 70 mm in advance of the line of contact of the printing roll with the paper surface in the sense of the direction of relative motion between the sector bearing the paper sample and the rolls. As a result of this configuration each paper sample was printed with a strip of solid colour 20 mm in width, the first 70 mm being printed on dry paper and the remaining 140 mm on prewetted paper. During operation the damping roll was biased against the paper sample with a force of 25 kg and the printing roll was biased against the sample with a force of 50 kg. Both the damping roll and the printing roll had an overall diameter of 68 mm.

Before each test the damping roll was loaded with a substantially identical weight of water, namely approximately 0.6 g of water per square metre of roll surface area by condensation of water vapour on the surface of the roll. The damping roll was placed in a refrigerator having an internal temperature of $-8 \pm 1^\circ \text{C}$ and a coiled temperature probe connected to a digital thermometer was placed in the central spindle hole of the roll. When the temperature recorded by the thermometer had fallen to $+5^\circ \text{C}$ the roll was transferred to a desiccator in which a humidity of 55% RH was maintained by means of a saturated solution of sodium dichromate. The temperature of the atmosphere in the thermometer had fallen to $+5^\circ \text{C}$ the roll was transferred to a desiccator in which a humidity of 55% RH was maintained by means of a saturated solution of sodium dichromate. The temperature of the atmosphere in the laboratory was controlled at $20 \pm 1^\circ \text{C}$. The roll was left in the desiccator for a time of 1 minute 55 seconds and the printability test was performed after another 5 seconds using a printing roll which had been pre-inked with Ault & Wiberg 4-Colour Process Gloss Magenta offset lithography ink.

The block of solid colour printed on the dry and prewetted areas, respectively, of the paper samples was tested for print gloss by means of a Hunterlab Glossmeter Model D16 and at an angle of 75° with the normal to the paper surface in accordance with TAPPI Standard NO.T480ts-65, the mean of five determinations for each area being recorded.

The block of solid colour printed on the dry and prewetted areas, respectively was also tested for print density by means of a Macbeth RD514 Reflection Densitometer, in this case, the means of ten determinations for each area being recorded.

As a comparison the same tests were performed on uncoated samples of the same base paper and the results are set forth in Table V below:-

TABLE IV

Gloss of solid colour area		Print density	
Dry	Wet	Dry	Wet
44	34	1.13	1.02
33	30	1.10	1.11

Claims

1. A paper suitable for gravure printing provided with a coating including a pigment consisting predominantly of a water-swellaible smectite-type clay, the coat weight being no greater than 5 gm^{-2} .

2. A paper according to Claim 1, wherein the coat weight is no greater than 1 gm^{-2} .

3. A paper according to Claim 2 or 3, wherein the pigment comprises at least 70% by weight of the smectite-type clay.

4. A paper according to Claim 1, 2 or 3, wherein the pigment comprises at least 80% by weight of the smectite-type clay.

5. A paper according to anyone of Claims 1 to 4, wherein the coating composition comprises an adhesive.

6. A paper according to Claim 5, wherein the adhesive is a starch or a latex.

7. A method of preparing a paper suitable for gravure printing which comprises the step of applying to the surface of a cellulosic sheet material an aqueous suspension comprising up to 20% by weight of a pigment which consists predominantly of a water-swellable smectite-type clay, the suspension being applied in an amount sufficient to provide a coating on the sheet material having a coat weight no greater than 5 gm^{-2} .

8. A method according to Claim 7, wherein the suspension further comprises an adhesive.

9. A method according to Claim 8, wherein the adhesive is a starch or a latex.

10. A method of gravure printing comprising printing onto paper coated with a composition including a pigment which consists predominantly of a water-swellable smectite-type clay, the coat weight being no greater than 5 gm^{-2} .

11. A method according to Claim 10, wherein the coat weight is no greater than 1 gm^{-2} .

12. A method according to Claim 10 or 11, wherein the pigment comprises at least 70% by weight of the smectite-type clay.

13. A method according to Claim 10, 11 or 12, wherein the pigment comprises at least 80% by weight of the smectite-type clay.

14. A method according to any one of claims 10 to 13, wherein the coating composition comprises an adhesive.



European Patent
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EUROPEAN SEARCH REPORT

Application Number

EP 88 30 2386

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl. 4)
X	US-A-3 508 952 (R.W.EYKAMP et al.) * Claims 1,2,4,5,7-10; examples 1,2 * ---	1-9	D 21 H 1/22 B 41 M 1/36
X	DE-C- 736 450 (J.BAUER et al.) * Whole document and in particular page 2, lines 4-6 * ---	1,7,10	
D,X	EP-A-0 192 252 (SÜD-CHEMIE) * Claims 1-3,8,17,18; examples 3,4 * ---	1,5-10, 14	
A	US-A-2 213 643 (W.H.ALTON) * Page 1, left-hand column, lines 1-8,22-39; right-hand column, lines 24-46; page 2, left-hand column, lines 13-62; right-hand column, lines 20-75; page 3, left-hand column, lines 1-9, example 4 * ---	1,5-9	
A	US-A-2 451 362 (R.M. SNYDER) * Column 2, line 12 - column 3, line 33 * ---	1,5,7,8	
A	GB-A-1 363 563 (SCM CORPORATION) * Claims 1,2,4-7,10-12 * ---	1,3-9	TECHNICAL FIELDS SEARCHED (Int. Cl. 4) B 41 M D 21 H
A	US-A-3 855 147 (W.T.GRANQUIST) * Abstract; column 6, lines 26,27 * ---		
A	GB-A- 762 744 (GENERAL CIGAR CO.) -----		
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 27-05-1988	Examiner NESTBY K.
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			