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(54) **Process for the manufacture of decorative laminates.**

(57) A process for the manufacture of a decorative laminate utilises a decorative laminate surface or overlay paper carrying a coating comprising a pigment and a binder. This coating affords improved printability without unacceptably reducing absorbency towards impregnating resins. The Gurley porosity of the coated paper is about 10-70 sec/100 ml; and the coating is present at a dry coatweight of up to 10 gm^{-2}, preferably 2.5 to 3 gm^{-2}. The coating is preferably applied by means of a size press. Laminate manufacture using the paper is conventional.

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PROCESS FOR THE MANUFACTURE OF DECORATIVE LAMINATES

This invention relates to a process for the manufacture of decorative laminates, to the laminates so made and to a paper for use in the process.

Decorative laminates are used, for example, for surfacing furniture, particularly kitchen or other furniture where it is desirable to have a water-resistant, easily-wipeable surface, for counter tops in shops and cafes and for building panels. They may be white or coloured, and may be plain or printed, for example with a woodgrain or other pattern. Printing may be in several colours, and is usually effected by a rotogravure technique.

One well-known type of decorative laminate (usually known as a high-pressure laminate) consists of several so-called core sheets for imparting strength to the laminate, a decorative sheet serving to mask the uppermost core sheet and to afford the laminate an attractive surface, and an overlay sheet on top of the decorative sheet (the overlay sheet becomes transparent during manufacture of the laminate, and so does not mask the decorative sheet). A so-called barrier sheet can be provided between the decorative sheet and the uppermost core sheet to afford an additional masking effect. All the sheets forming the laminate are impregnated with a thermo-setting resin, for example a phenolic resin or a melamine-formaldehyde or other aminoplast resin (the various sheets making up the laminate are not usually all impregnated with the same resin). The impregnating resin in the case of the decorative sheet is most commonly a melamine formaldehyde resin. In the final impregnated sheet, the resin is usually present in an amount of the order of 100% w/w.

If the decorative laminate is to be of a printed design, the decorative sheet normally carries the print. Alternatively, however, the overlay sheet may carry the print on its surface which contacts the decorative sheet.

The core sheets are normally of strong, relatively inexpensive paper, for example unbleached softwood kraft paper. Such paper is not of uniform or particularly attractive appearance, and is not suitable for high quality printing. For this reason, it is necessary for the decorative sheet to be sufficiently opaque to mask the unattractive and non-uniform appearance of the uppermost core sheet, and for it to be suitable for high quality printing.

In another type of decorative laminate (usually known as a low-pressure laminate), a sheet of chipboard or similar material is used directly as a support for the decorative sheet, instead of the core sheets. The decorative sheet in such a laminate serves to mask the chipboard rather than the core sheets. Again, it is necessary for the decorative sheet to be opaque and to be suitable for high quality printing. Barrier sheets are not normally used in this type of laminate since chipboard is normally of a lighter shade than core sheets and hence is more easily masked.

The paper which is used for making decorative sheets is known as plastic base surface paper. In addition to being opaque and suitable for printing, it must be absorbent so that it may easily be impregnated with resin during a single pass through an impregnating bath, which typically takes about 20sec. The same applies to the overlay sheet if it is to be printed. The absorbency of plastic base surface paper, as measured by the Klemm method, is typically in the range 30 to 65 mm/10 min if for use in a high-pressure

laminate, or in the range 25 to 45 mm/10 min if for use in a low-pressure laminate (in the Klemm method a strip of paper 15 mm wide is suspended vertically with one end in a dish of the liquid concerned and the distance the liquid soaks up the paper in ten minutes is measured). The absorbency of an overlay sheet is typically in the higher part of the range quoted for plastic base surface paper for use in a high-pressure laminate. The absorbency of plastic base surface paper may also be quoted in terms of porosity as measured by a Gurley porosity tester, since porosity is related to speed of absorbency in this instance. Plastic base surface paper typically has a Gurley porosity (20 oz) in the range 10 to 25 sec/100 ml preferably 20 to 25 sec/100 ml, if for use in a high-pressure laminate, or in the range 15 to 50 sec/100 ml if for use in a low-pressure laminate, although values of 70 sec/100 ml or more are acceptable.

The requirement for plastic base surface paper and overlay paper to be absorbent results in a relatively rough paper surface which is not particularly suitable for high quality gravure printing. There are two main problems. First, the rough surface makes it difficult to obtain complete print coverage from every gravure cell. Second, the absorbent nature of the paper allows ink to penetrate into the sheet and print intensity is therefore reduced.

Despite these problems, plastic base surface and overlay paper can be printed to a high standard, provided larger quantities of ink are used than would be needed on a good printing surface or provided a lower absorbency is acceptable.

It might be thought that the above-described problems could be simply overcome by the application of a pigment

coating such as is commonly used in the manufacture of high quality printing papers. However, such coatings enhance printability not only by increasing surface smoothness, which would be acceptable in plastic base surface and overlay papers, but also by decreasing absorbency to an extent which would not be acceptable in such papers. Pigment-coated art papers, for example, typically have a Klemm absorbency below 5 mm/10 minutes, which is well below that required in plastic base surface and overlay papers.

However, it has now been found that, contrary to previous expectations in the art, the printability of plastic base surface and overlay papers can be improved without unacceptably reducing the capacity of the paper to absorb impregnating resins by applying to the paper a coating containing a pigment and a binder.

Accordingly, the present invention provides in a first aspect a process for the manufacture of a decorative laminate comprising the steps of applying a liquid coating composition comprising a pigment and a binder to a surface of a previously formed and dried decorative laminate surface or overlay paper to give a coatweight when dry of up to $10gm^{-2}$ on said surface, the resulting coated paper having a Gurley porosity (20 oz) of about 10 to 70 sec/100 ml, printing a desired pattern on said coated surface of said paper, impregnating the resulting printed paper with a thermo-setting resin and laminating the impregnated paper to a support therefor under conditions effective to cure the resin, thereby to produce said decorative laminate.

In a second aspect, the present invention provides a decorative laminate surface or overlay paper carrying a coating composition comprising a pigment and a binder on a surface thereof at a coatweight of up to $10gm^{-2}$, said paper

having a Gurley porosity of about 10 to 70 sec/100 ml and said pigment being kaolin, calcium carbonate, titanium dioxide or barium sulphate.

In order to ensure that the absorbency of the present plastic base surface or overlay paper is at a suitable level and that the surface smoothness of the coating is at an optimum level, the coatweight and the weight ratio of pigment to binder must be chosen carefully. The preferred dry coatweight is in the range of from 2.5 to 3gm^{-2}. The weight ratio of pigment to binder in the coating is preferably in the range 5:1 to 1:1, more preferably from 2.5:1 to 3.5:1. The Gurley porosity (20 oz) of the coated paper is preferably in the range 20 to 50 sec/100 ml.

The pigment is preferably one having a Mohs' hardness of less than 7, for example kaolin, calcium carbonate in precipitated or ground form, titanium dioxide or barium sulphate. Pigments having a Mohs' hardness greater than 7, such as alumina or hydrated alumina, various natural or synthetic alumino-silicates or silica or silica gel may however be used. The binder may be starch, casein, latex, polyvinyl alcohol or an aminoplast or other cross-linking resin.

Preferably the liquid coating composition comprising the pigment and binder is applied by size press treatment, although other coating techniques may be used, for example air-knife coating. It will be appreciated that size press treatment normally results in a coating being applied to both surfaces of the paper web.

Once the decorative laminate surface or overlay paper has been coated it may be calendered before being impregnated.

The present plastic base surface or overlay paper enables an improvement in print quality to be obtained as a result of more complete ink transfer from the gravure cells and of less ink absorption. It also permits a reduction in ink usage for a print of specified quality, or, for the same ink usage affords a better print than would be obtained on the same paper if it were not coated.

The invention will now be described with reference to the following examples :

EXAMPLE 1

A sheet of plastic base surface paper having a grammage of 100gm^{-2} was size press coated with an aqueous coating containing a mixture of kaolin (supplied by English China Clays under the designation "Supreme"), esterified starch and melamine-formaldehyde resin in a weight ratio of 3:1:0.001. The coating was then dried, the dry coatweight being 3gm^{-2}. The absorbency of both the coated and the uncoated paper was found to be 30mm/10 min. The Gurley porosity (20 oz) of the coated paper was found to be 24 sec/100 ml, and that of the uncoated paper was 18 sec/100 ml.

Both the coated paper and a sample of uncoated plastic base surface paper were then printed with the same amount of ink using a gravure printing process. On examination of the printed papers, it was found that the optical reflectivity of the uncoated paper (as measured by an Elrepho opacimeter) was 20% whereas that of the coated paper was 10%. Both papers absorbed a sufficient amount of resin to make satisfactory laminates and the colour or shade of the unprinted surface of a laminate containing the coated paper was judged to be the same as that of a laminate containing uncoated paper.

EXAMPLE 2

A sheet of plastic base surface paper having a grammage of 120gm^{-2} was size press coated with an aqueous coating containing a mixture of barium sulphate (precipitated), esterified starch and melamine formaldehyde resin in a weight ratio of 3:1:0.001. The coating was then dried and calendered, the dry coatweight being 7gm^{-2}. The Gurley porosity (20 oz) of the coated paper was found to be 26 sec/100 ml, and that of the uncoated paper was 14 sec/100 ml.

Both the coated paper and a sample of uncoated plastic base surface paper were then printed with the same amount of ink using a gravure printing process. On examination of the printed papers, it was found that the optical reflectivity of the uncoated paper (as measured by an Elrepho opacimeter) was 20% whereas that of the coated paper was 18%. Both papers absorbed a sufficient amount of resin to make satisfactory laminates and the colour or shade of the unprinted surface of a laminate containing the coated paper was judged to be the same as that of a laminate containing uncoated paper.

EXAMPLE 3

A sheet of plastic base surface paper having a grammage of 120gm^{-2} was size press coated with an aqueous coating containing a mixture of titanium dioxide (supplied by British Titan Products, under the designation ALF), esterified starch and melamine formaldehyde resin in a weight ratio of 3:1:0.001. The coating was then dried and calendered, the dry coatweight being 6.6gm^{-2}. The Gurley porosity (20 oz) of the coated paper was found to be 69 sec/100 ml, and that of the uncoated paper was 14 sec/100 ml.

Both the coated paper and a sample of uncoated plastic base surface paper were then printed with the same amount of ink using a gravure printing process. On examination of the printed papers, it was found that the optical reflectivity of the uncoated paper (as measured by an Elrepho opacimeter) was 20% whereas that of the coated paper was 17%. Both papers absorbed a sufficient amount of resin to make satisfactory laminates and the colour or shade of the unprinted surface of a laminate containing the coated paper was judged to be the same as that of a laminate containing uncoated paper.

EXAMPLE 4

A sheet of plastic base surface paper having a grammage of 120gm^{-2} was size press coated with an aqueous coating containing a mixture of calcium carbonate (under the designation Hydrocarb) esterified starch and melamine formaldehyde resin in a weight ratio of 3:1:0.001. The coating was then dried and calendered, the dry coatweight being 5.5gm^{-2}. The Gurley porosity (20 oz) of the coated paper was found to be 50 sec/100 ml, and that of the uncoated paper was 14 sec/100 ml.

Both the coated paper and a sample of uncoated plastic base surface paper were then printed with the same amount of ink using a gravure printing process. On examination of the printed papers, it was found that the optical reflectivity of the uncoated paper (as measured by an Elrepho opacimeter) was 20% whereas that of the coated paper was 17%. Both papers absorbed a sufficient amount of resin to make satisfactory laminates and the colour or shade of the unprinted surface of a laminate containing the coated paper was judged to be the same as that of a laminate containing uncoated paper.

CLAIMS

1. A process for the manufacture of a decorative laminate comprising the steps of applying a liquid coating composition comprising a pigment and a binder to a surface of a previously formed and dried decorative laminate surface or overlay paper to give a coatweight when dry of up to $10gm^{-2}$ on said surface, the resulting coated paper having a Gurley porosity (20 oz) of about 10 to 70 sec/100 ml, printing a desired pattern on said coated surface of said paper, impregnating the resulting printed paper with a thermo-setting resin and laminating the impregnated paper to a support therefor under conditions effective to cure the resin, thereby to produce said decorative laminate.

2. A process for the manufacture of a decorative laminate as claimed in claim 1 wherein the coating is applied to said surface of the previously formed and dried decorative laminate surface or overlay paper at a coatweight of 2.5 to $3gm^{-2}$.

3. A process for the manufacture of a decorative laminate as claimed in claim 1 wherein the Klemm absorbency of the plastic base surface paper is in the range 25 to 65 mm/10 min.

4. A process for the manufacture of a decorative laminate as claimed in claim 1 wherein the pigment has a Mohs' hardness of less than 7.

5. A process for the manufacture of a decorative laminate as claimed in claim 4 wherein the pigment is one of kaolin, calcium carbonate, titanium dioxide or barium sulphate.

6. A process for the manufacture of a decorative laminate as claimed in claim 1 wherein the weight ratio of pigment to binder is in the range 5:1 to 1:1.

7. A process for the manufacture of a decorative laminate as claimed in claim 6 wherein the ratio of pigment to binder is in the range 2.5:1 to 3.5:1.

8. A process for the manufacture of a decorative laminate as claimed in claim 1 wherein the coating is applied by size press treatment.

9. A process for manufacture of a decorative laminate as claimed in claim 1 wherein the binder is one of starch, casein, latex, polyvinyl alcohol, or an aminoplast or other cross-linking resin.

10. A decorative laminate as produced by the process as claimed in claim 1.

11. A decorative laminate surface or overlay paper carrying a coating composition comprising a pigment and a binder on a surface thereof at a coatweight of up to $10gm^{-2}$, said paper having a Gurley porosity of about 10 to 70 sec/100 ml and said pigment being kaolin, calcium carbonate, titanium dioxide or barium sulphate.

12. A paper for use in the manufacture of a decorative laminate as claimed in claim 11 wherein said coating composition is present at a coatweight of 2.5 to $3gm^{-2}$.

13. A paper for use in the manufacture of a decorative laminate as claimed in claim 11 wherein the weight ratio of pigment to binder is in the range 5:1 to 1:1.

14. A paper for use in the manufacture of a decorative laminate as claimed in claim 13 wherein the weight ratio of pigment to binder is in the range 2.5:1 to 3.5:1.

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EUROPEAN SEARCH REPORT

Application number
EP 81 30 5807

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim
X	US - A - 3 798 111 (C.W. LANE et al.) * Figures 1,2; column 1, line 13 to column 5, line 57 *	1,9-11
X	FR - A - 2 376 746 (EXXON RESEARCH AND ENGINEERING) * The whole document, in particular, page 9, lines 27-34 * & GB - A - 1 591 954 (01-07-1981)	1,9-11
X	GB - A - 2 033 249 (NEVAMAR) * The whole document, in particular page 6, lines 16-19 *	1,9-11
X	FR - A - 1 048 836 (OXVAR) * The whole document, in particular page 2, right-hand column, lines 31-54 and page 3, left-hand column, lines 38-46 * & GB - A - 674 149	1,4,5, 10,11
X	GB - A - 653 531 (H.J. MALLABAR) * Page 3, lines 5-96 *	1,4,5, 10,11
X	US - A - 3 578 483 (L.M. GARCIA) * The whole document *	1,2, 4-6, 9-13
A	AT - B - 332 107 (ISOVOLTA) * The whole document *	1,4-6 9-11, 13

CLASSIFICATION OF THE APPLICATION (Int. Cl. 3)

D 21 H 5/00
B 41 M 1/36
7/00
B 44 C 5/04

TECHNICAL FIELDS SEARCHED (Int.Cl. 3)

B 41 M
B 44 C
D 21 H

CATEGORY OF CITED DOCUMENTS

X: particularly relevant if taken alone
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A: technological background
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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

X The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	19-02-1982	NESTBY