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PAPER AND PROCESS FOR MANUFACTURE

Raymond A. Steffen, Hamilton, Ohio, assignor to Champion Papers Inc., a corporation of Ohio

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This invention is concerned with a process for producing a printing paper, particularly such a paper suitable for use as labels, for cans, packages and the like, liners, covers, etc., or more broadly to that class of stock commonly referred to as litho stock, or coat one side paper.

Printing papers of the type referred to are readily available on the market. Because of their use, they are generally characterized by brightness and opacity which make them suitable for lithographic or label printing where, in many cases, multiple colors may be used. Generally, litho papers are provided with some type of coating to render one surface uniformly receptive of inks used in printing and, further, such papers are also subject to a calendering operation to render the surface smooth and to provide a high gloss thereon. As is well known, calendering has an adverse effect on opacity.

Since brightness and opacity are critical, consideration must be given to the problem of securing suitable opacity and brightness either or both of which are affected by such factors as color of the pulp, coatings, and tints to be applied to the finished stock, and the like. In many cases, because the pulp used is productive of a stock which lacks opacity at a given weight of paper, or because the calendering operation reduces such opacity as the paper may have to an unacceptable level, it has been customary to add fillers in the stock during beating, prior to entry of the pulp into the paper machine. Such fillers increase the scattering of light within the stock rendering the finished sheet more opaque than it would naturally be, if no fillers were added. However, in many cases opacity increases result in a loss of brightness which is totally undesirable from the printing and sales viewpoint. On the other hand, it is also known that the addition of certain pigments, principally titanium dioxide, TiO_2, either into the pulp during beating or in the form of coatings, or both, will not only increase opacity but will also add to the brightness of the finished stock. The latter method, however, has a major distadvantage in that the addition of TiO_2 adds to the manufacturing cost of the paper and in some cases where the pulp is of such a nature as to produce a paper severely lacking in opacity, the loading thereof with TiO_2 produces adverse results. For example, such loading raises costs to an almost prohibitive figure as well as weakens the stock creating problems in the printing thereof, particluarly in high speed continuous lithographic printing machines such that only a given amount of fillers may be used without adversely affecting the printing qualities of the paper, or a minimum of filler is used resulting in a paper lacking in opacity and brightness.

The present invention, therefor, has for an object the production of a bright, opaque, highly acceptable paper for use in lithographic printing processes.

Another object of the invention is to produce a paper of maximum opacity and brightness obtained by the minimum use of fillers and the like.

Still a further object of the invention is to produce a

coated paper of acceptable brightness and opacity, wherein the manufacturing costs may be substantially reduced.

Another object of the invention is to produce a bright, opaque paper that is economical to manufacture, commercially competitive, yet permits of substantial reductions in the use of fillers, brightening agents, etc., such as TiO_2.

An additional object of the invention is to produce a bright, opaque paper which is particularly adapted for use as labels, covers, liners, etc.

A further object of the invention is to produce an all purpose paper stock wherein acceptable shades may be obtained along with suitable opacity and brightness while permitting a substantial reduction in the use of fillers, brighteners or the like.

These and other objects of the invention may be accomplished by the method of applying to a paper stock, by one means or another, one of a class of dyes having the particular characteristic of increasing opacity but without substantial reduction in brightness, the dye being applied solely to the backside of the stock within a range of certain concentrations and further, in some cases, in controlling the tints that may be included in the pulp and/or coatings if used or both. The front side of the stock is generally the only side coated with a mineral coating that provides a good printing surface.

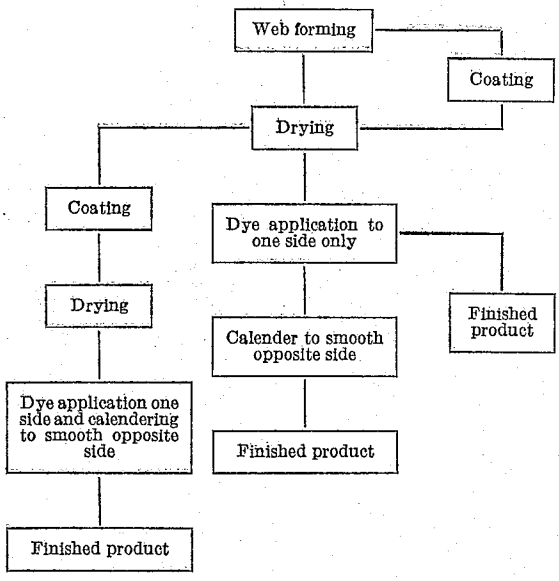
One manner of carrying out the instant method for producing bright, opaque label paper stock may be by the use of equipment similar to that disclosed in Montgomery patent 2,251,890. That patent discloses a means for applying liquid to a moving web as it passes between the rolls of a supercalender stack. The means includes a suitable wetting roll to apply liquid to a web and a wiper to remove excess water over and above that necessary to assure proper finishing as the web passes through the calender. It has been found that the liquid applicator and wiper action of the apparatus disclosed in the patent will apply a fairly well controlled and fixed amount of liquid such that varying the concentrations of substances that might be included in the liquid will result in close control of the amount of such substances as may be deposited on a web.

Another method of carrying out the invention might well be on the paper machine itself. For example, the dye can be applied to the web at the machine calender stack or somewhere in the dryer section of a paper machine. Regardless of the manner of application, it must be accomplished in such a manner that the dye solution is applied evenly and at a well controlled rate on what will be the uncoated side of the web, such that control of the shade of the dyed web is a function of the amount of dye contained in the liquid applied to the paper, rather than a function of the amount of liquid applied to the paper.

In the practice of the present invention one of the various types of liquid applicators is arranged so as to apply liquid to one side of a moving web. In all cases the applicator applies a proper solution of a suitable dye to one side of a paper. In most instances the dye is applied only to that side of the web which is not coated or intended as a printing surface. The dye, if of the type to be described, has the effect of increasing opacity of a sheet of the paper with only a minor reduction in brightness as measured on the print receptive surface. In practic-

ing the invention favorable results have been obtained by using a blue dye having a peculiar property of increasing opacity, with a minimum reduction of reflectivity i.e., brightneess of a paper as measured in accordance with the standard opacity and brightness test procedure i.e., TAPPI, for opacity, and G.E. for brightness, as set up by The Institute of Paper Chemistry for evaluating these qualities in a paper.

A simplified flow diagram illustrating a manner of accomplishing the process is as follows:



Since shade or hue of the commercial product is so important the effect of a given dye on this final hue or shade, i.e. color of the printing surface of the paper, must be carefully considered. It was found during the trials on at least two shades of raw stock that, within a limited range, a given dye could be applied in sufficient amounts to increase opacity several points yet produce a specific tint or shade on the printing side of the sheet, while having a minimum effect on brightness of the printing side of the paper. In some cases, the untreated stock was a neutral shade, that is, it contains little if any coloring or tints and in other cases, the stock was so called regular stock having limited amounts of blue and red tints added as is customary in the art. It has been found that in all cases the opacity of the calendered stock as viewed from the front side was increased by the application of Pontamine Fast Blue 3RNP or its equivalent, on the backside of the stock, and that the controlling factor as to concentration of the dying solution is the shade produced on the front, i.e. printing surface of the sheet. The following examples indicate the manner in which the invention can be carried out. In each example, the paper stock was 60# per 25 x 38, 500 sheet ream, all tests for brightness and opacity were made in accordance with the standards set up for the industry by The Institute of Paper Chemistry.

The particular dye used as an example hereinafter is Pontamine Fast Blue 3RNP as manufactured by the E. I. du Pont de Nemours Co. This dye has been selected from among others, of which some are listed below, because, in addition to the specific qualities as regards brightness and opacity, it exhibits other qualities such as light fastness, water solubility, and because generally, its excellent properties make it easy to handle and readily useable. In addition since a blue-white hue is most pleasing to the eye, blue having the quality of making white appear even more white, a blue was believed preferable to other colors, although it has been found that certain other colors of dyes do have similar properties, though not in all cases quite as good as blue.

Among the dyes which can be used to effect the invention are the following, rated in terms of their affect on opacity with minimum affect on brightness:

"Pontacyl" Violet C4BN	Excellent.
"Pontamine" 3RNP Blue	Good.
Methyl Violet	Fair.
"Pontamine" Black E Double	Fair.
Aurasperse Phthalocyanine Blue W4021	Good.

While some of the above listed dyes are rated not quite as good as others, it will be realized that such additional factors as have been mentioned in connection with "Pontamine" Fast Blue 3RNP may dictate the preference for one dye over another. In addition the hue, i.e. color of the paper deemed most desirable may also and, in fact, often does dictate the choice of one dye over another. While the word dye is used throughout the specification it will be appreciated that it is not used in a limiting sense, but is meant to include such substances as may be used to give a hue or tint or shade to the paper, such as water soluble dyestuffs, dispersions of pigments and the like. The invention is therefore not intended to be limited to a particular dye, or dyestuff, though water soluble dyes are the most convenient to use because of the extensive use of water in papermaking coating and finishing operations. For example a so called pigmented dyestuff can produce desirable results if properly dispersed in a liquid medium. A specific example is a pigmented dye such as Aurasperse Phthalocyanine Blue W4021 manufactured by Zinnser & Co. dispersed in water and applied to the uncoated side of a standard litho sheet. This pigmented dispersion gave results quite similar to the results outlined below.

In the following examples of the manner of practicing the invention a regular tinted stock was used and the results after supercalendering were as follows:

Stock	Percent Dye in Solution	Opacity [1] (TAPPI)	Brightness [1] (G.E.)	Comment
Control	0	88.2	75.50	
Reg	0.125	94.1	73.40	Too dark.
Reg	0.0625	92.3	74.36	Acceptable shade.
Reg	0.03125	90.9	74.6	Do.
Reg	0.015625	90.1	75.2	Do.
Reg	0.0078125	89.4	75.0	Do.

[1] All measurements on coated, i.e., printing surface.

It was found that in all cases with regular stock, i.e., stock containing tints in both pulp and one side coating, there was an increase in blueness on the printing side of the sheet, which ranged from a deep blue at 0.125% to an acceptable blue white upon the application of solutions containing between 0.0625% and 0.03125% blue dye solutions. It will also be noted that this range gave the greatest increase in opacity while brightness of the sheets was affected the least.

Similar results were obtained when the dye was applied to a neutral stock, that is, a paper stock having little or no tints added in either coating or pulp. Again, the amounts of dye in the aqueous solution were varied to obtain the most favorable ranges of color. In this case, however, since the neutral stock was less blue in shade, as viewed from the coated side, it was found that more dye, approximately 0.2% in solution, could be applied to the back before the shade of the printing surface became too blue to be acceptable. On a neutral sheet having an initial opacity of 89.4 and a brightness of 79.3 after calendering of the printing surface, it was found that a solution containing 0.1% by weight of the blue dye increased opacity to 92.4 while brightness was 78.4 and the final shade of the sample was adjudged to be exceptionally close to the standards for such paper. With the exception of the fact that the neutral shade permitted the use of more dye on the backside of the sheet, the results were substantially similar to those obtained from tinted stock indicating quite clearly that hue, or final

shade was the limiting factor in the amount of dye that can be used. Thus it may be seen that the percentages of dye in solution are a function of the intensity of the dye and that a range of from .015625 to 0.2% by weight are well within the preferable range of concentrations of solutions giving favorable results, although a wider range of concentrations may be used on occasion.

From the above results it may be seen that the application of one of a selected group of given dyes having the property of increasing opacity of paper, yet producing a minimum reduction of brightness of the coated side of a sheet, enables the paper to be made with a minimum of filler and further, that various combinations of tints in the stock, tints in the coating applied to the printing surface and tints applied directly to the back of the stock can produce an opaque, bright printing paper having excellent printing properties.

As has been stated, beneficial results can be obtained by the sole application of dye of the disclosed characteristics to the opposite side of a paper than that which is to receive printed material. In carrying out the invention on a commercial scale, however, it has been found desirable to not only apply dye to the backside of the sheet, but also to include some dye in both the pulp at the beaters and in the coating. This combination of dye in pulp, coating, and on one side of a sheet is highly effective because it has been found that in many cases the pulp will not always be the same shade before it is to run onto the paper machine. Also in some cases the definite blue hue that is present on the back of a one side coated sheet is objectionable. Accordingly, it has been found that favorable results can be obtained by reducing the normal amount of blue used in the coating, maintaining a fairly constant shade of pulp and then applying to the uncoated side of the paper a concentration of dye sufficient to produce the shade required on the coated side thus resulting in high opacity at the selected shade when the paper is viewed from the coated side. Examples of this practice are as follows, all readings after calendering.

Stock	Percent Dye in Solution Backside	Percent Dye in Coating	Opacity, [1] TAPPI	Brightness, [1] G.E.
Neutral	0	0	84.4	79.3
	0.1	0	92.4	78.4
	0.03	0.03	90.5	78.5
	0.05	0.02	91.2	78.1
	0.075	0.005	91.6	77.9

[1] As measured on coated, i.e., printing surface.

In the examples cited above, the dye used in both coating and on the back was "Pontamine" Fast Blue 3RNP. It has been found that a combination of about .04% of a suitable tinting solution applied to the back and about 0.03% weight of dye in the coating produces a paper deemed commercially acceptable and, in fact, so it is, as evidenced by the huge quantities thereof used in the printing trade.

Although the favorable results were obtained on 60#/ream paper it will be appreciated that the advantages of the invention can be realized on any weight paper where an increase in opacity is desired and wherein the product is to be printed on only one side, such as is the case with a one side coated paper which is intended for use in forming labels, etc., as described above.

Having thus described the invention, it will be apparent that variations in the practice thereof are possible, all of which fall within the spirit and scope of the inventive concept which is limited only as defined in the following claims, wherein, what is claimed is:

1. A lithographic printing paper having the properties of high brightness and low opacity and one coated surface formed by the process of applying a mineral coating on one side thereof, applying a dye in the form of an aqueous solution containing from 0.2% to 0.015625% by weight of the dye to the opposite side thereof, said dye having the property of increasing opacity of the paper yet having a minimum adverse effect on brightness as measured from the coated surface of the paper, and calendering of the coated, finished paper to improve the printing quality of the coated surface thereof and wherein the paper is characterized in that it is substantially free from filler materials.

2. The method of manufacturing printing paper stock having one coated printing surface and high opacity and brightness, comprising the steps of coating one side of a paper stock with a mineral coating, thereafter applying a aqueous finishing solution containing from 0.2 to 0.0156 percent of a blue dye to the opposite side of the stock while calendering the coated dyed stock to smooth the coated surface, the blue dye having the properties of increasing opacity of the stock without materially affecting the brightness thereof as measured by standard measuring procedure on the coated surface of the stock.

3. The method of increasing the opacity of printing papers having at least one surface adapted to receive printed matter and characterized by the property of low opacity comprising the steps of forming a pulp into a web coating the web to form a surface adapted for receipt of printed matter drying the web and thereafter treating the opposite surface of said web by the application of an aqueous solution containing from 0.01% to 0.02% of a dye, said dye having the property of increasing the opacity of the sheet while not materially affecting the brightness of the printing surface.

4. The method of manufacturing printing paper stock having at least one surface coated with a mineral pigment to define a printing surface and characterized by its qualities of high opacity and brightness, comprising the steps of forming a dye containing pulp into a web, coating the formed web on at least one surface with a mineral pigment coating containing from .005% to 0.03 percent by weight of a dye having the property of rendering the formed web opaque without materially affecting the brightness of the coated surface drying the coated web, thereafter applying an aqueous solution containing from 0.03% to .1% by weight of said dye to the opposite surface of said formed substantially dry web.

5. The method of manufacture of printing paper stock as defined in claim 4 wherein the formed web is calendered and wherein said aqueous dye containing solution is applied directly to the surface of the web during said calendering operation.

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