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COATED PAPER AND METHOD OF MAKING THE SAME

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This invention relates to coated paper and methods of making same, and more particularly to coated paper having a "cast" finish surface such as described in Patent No. 1,719,166, issued July 2, 1929 to Donald B. Bradner, one of the present applicants.

The paper of the present invention is eminently adapted to the production of can and bottle labels, of cigarette and other packages, for fancy candy box wrappings, for carton liners, for book jackets, magazine covers, advertising folders and other uses.

As pointed out in the above mentioned patent, coated papers of especially high gloss and unusual smoothness may be obtained by the casting processes therein described.

The invention of the present application is based primarily upon the discovery that the application of the coating compositions in two or more layers produces a coated paper having properties not found in a paper made according to the said Bradner patent in which the coating is applied in one layer. This is true whether the successive applications of coating are of the same or different composition.

The cast coated papers with a single coat as described in the Bradner patent have frequently suffered from microscopic defects which detracted from the appearance and interfered with fine printing. Among the defects noticeable upon microscopic or naked eye examination of the paper may be mentioned the following:

Trenches.—This is a condition readily observed under a low power microscope, in which a coating, instead of being smooth and uniform, presents a surface containing shallow trenches that follow certain of the surface fibers of the underlying paper. When viewed with transmitted light these trenches are seen to be more transparent than the surrounding coating.

Crevices.—Microscopic irregular shaped holes in the coating having the appearance of shrinkage cracks.

Holes.—Microscopic rounded holes having the appearance of being caused by minute gas bubbles in the coating.

Stipple.—A condition of the coating readily seen by the naked eye by transmitted light. The coating is in thick and thin areas spaced a millimeter or two apart. This condition is often observable by reflected light.

Mottle and streaks.—When looking over the surface of the paper numerous small dull blotches may be apparent where the light is not uniformly reflected. When examined under the micro-

scope it can frequently be determined that this lack of uniformity is due to the concentration of trenches, crevices, or holes in certain areas or lines.

Cockle.—A condition of the cast coated paper which has the cockled appearance of air dried bond paper as contrasted with a flat calendered paper.

We have discovered that these defects are due to various more or less obscure causes which are related to unequal absorption of the vehicle into the paper, unequal drying and shrinkage of the coating material, and to swelling of the fibers due to the water in aqueous coating composition, and their subsequent shrinkage.

We have found that cast surfaced coated paper is nearly or quite free from the above mentioned defects when the coating is made up of two or more layers instead of a single layer as described in the patent to Bradner, even though the total weight of coating is no greater than in the case of the single layer. The two layers may be made of the same or different composition and chosen to give the properties desired in the finished paper without sacrificing the advantages mentioned.

The double coated paper of this application may be produced by the method described in the aforesaid patent to Bradner by using coated paper as the base to which the Bradner coating is applied. The coated paper used as the base for the application of the cast-coat may carry a coating applied on the paper-making machine or a subsequently applied coating and may be air dried, calendered, supercalendered, or cast surfaced as desired.

The improvement is not in any sense a covering of defects in one coat by a superimposed coat, but an actual absence in the cast coat superimposed on a base coat of defects, which are present in a cast coat lying directly on the paper.

The reason for the phenomenal improvement resulting from applying a cast surfaced top coat to paper carrying a previously applied base coat is not apparent. It is believed that the absorbing power of the base coat being greater or more uniform than that of uncoated paper, materially increases the smoothness and uniformity of spreading of the top coat and the uniformity of drying. Also the base coat is believed to protect the fibrous paper web underneath against wetting and swelling when the top coat is applied. Furthermore, only a part of the total weight of coating is applied at this time and the base to which it is applied is heavier, consequently the degree of

wetting of the base by the added top coat is greatly reduced, thus proportionately reducing any defects due to wetting.

The defects found in the single coated papers, as described, are ordinarily reduced to a greater extent when the top coat applied by the Bradner process is made of an exceptionally light weight, e. g., 2 pounds per 1000 square feet or less, than when heavier top coats are used.

There are, however, various types and grades of paper wherein a heavier outer coat is desirable and by employing under-coated stock as herein described a thick cast outer coat may be obtained which is, as pointed out, greatly superior to the coatings heretofore obtained.

We have also discovered that by casting an outer coating of one composition over a previously applied undercoat of a different composition, coated paper having characteristics (other than the correction of the above mentioned defects) not obtainable at all with a single coating applied at one operation may be obtained, depending on the composition and character, respectively, of the two coatings.

Our invention will be better understood from a consideration of the following examples:

Example 1

A usual grade of coating stock was coated with 4.8 pounds per 1000 square feet of a coating comprising 87% precipitated calcium carbonate and 13% casein and given a cast surface by drying in contact with a mirror-finished chromium plated drum. The paper was then re-coated with 1.2 pounds per 1000 square feet of the same coating and dried against the same surface.

The appearance presented by the paper coated as above described was distinctly superior to the paper before the second coat was applied, and it was also distinctly superior to paper in which the same total weight of coating was applied in one step and given a cast surface as described in Patent No. 1,719,166. Unlike the single-coated product, the double-coated product was essentially free from the surface defects previously enumerated.

Example 2

A usual form of machine-finished coating stock weighing 50 pounds per ream of 500 sheets 25 x 38 inches was coated with 4.8 pounds per 1000 square feet of a coating consisting of 30 parts of clay, 47 parts of calcium carbonate, 23 parts of satin white, and 17 parts of casein and then supercalendered to a smooth, even finish. On top of this base coat a top coat containing about 30 parts of clay and 70 parts of casein, was applied in an amount of about .6 pound per 1000 square feet and given a cast surface as described in Patent No. 1,719,166.

This paper possessed a very high degree of gloss, had a fine white color, and the surface was substantially free of defects. It was non-absorptive to printing ink so that gloss inks dried with their full gloss.

A paper having a coating of the composition and weight of the undercoating above specified and provided with a cast surface according to the said patent is a product of good color and opacity, but having a surface marred by microscopic imperfections. It is highly absorptive to ink, so that a gloss ink loses its full luster when applied, which is rendered more apparent by the high gloss of the unprinted areas.

In case a normal weight of the top coating com-

position specified in the example were applied directly to the paper rawstock, and given a cast surface in the manner described, the coating would not hide the color and texture of the rawstock and it would have an imperfect surface.

This two step coated paper presents an appearance of depth due probably to the fact that the thin top coating with high adhesive content is nearly transparent so that the fine white surface of the first applied coating is visible there-through and is enhanced in appearance by the mirror-like smoothness of the outer layer.

Instead of employing for the outer coat a mixture of casein and clay the coating may consist of casein alone, but as casein is 10 to 20 times more expensive than clay, it is desirable to use an admixture of clay to the extent permissible without impairing the surface characteristics of the paper. We have discovered that with thin outer coatings of the character described, as much as 50% clay may be incorporated in the casein and the desired surface characteristics obtained with a less quantity of casein although the total weight of the coating required is greater with the mixed coating than with the casein alone.

Example 3

A high grade supercalendered coated paper, comprising a paper stock carrying a coating consisting of clay, calcium carbonate, satin white and casein was used as the base for the application of 1.2 pounds per 1000 square feet per side of a cast surfaced coating consisting of 17% casein and 83% coating clay. This product was essentially free from any of the surface defects previously mentioned, gave excellent printing results with regular halftone ink, and had an exceptionally attractive appearance.

Example 4

A paper base weighing 12 pounds per 1000 square feet made from sulfite and soda pulp moderately sized with rosin size and containing a little clay filler was coated on the paper machine with 2.1 pounds per 1000 square feet of a coating composition containing 10.8% casein, 53.6% clay, and 35.6% of precipitated calcium carbonate. This machine-finish paper was given a cast coating weighing 3.6 pounds per 1000 square feet and consisting of 87% precipitated calcium carbonate and 13% casein. This coating showed no holes, stipples, or mottle. It was not entirely free from cockle, crevices, and trenches, but these defects were greatly diminished in frequency and intensity by virtue of the undercoat.

In the foregoing examples the coating compositions included alkalies to disperse the casein, also miscellaneous materials such as dyes, soaps, foam killers, etc., known in the art.

The coating compositions to be used may comprise other adhesives and other mixtures of adhesive and filler in any desired proportion. Advantageously the adhesive and filler are prepared in a water dispersion and the filler is preferably a mineral filler such as clay, calcium carbonate, blanc fixe, satin white, etc. However, the invention is not limited to aqueous coatings. Non-aqueous solvents or vehicles may be used. Thermoplastic coating compositions may also be employed.

In our prior Patent No. 2,029,273 issued January 28, 1936, we have disclosed among other novel types of paper having cast coatings, several kinds of double-coated paper, all of which novel

coated papers are also disclosed in our co-pending application Serial No. 31,915, filed July 17, 1935, and constituting a division of the above designated Bradner and Montgomery patent. The present application is a continuation-in-part of said application. The outer cast coatings herein described may be applied by the casting process described and claimed in said patent and this process presents some advantages over the casting process described in the Bradner patent, particularly for the thicker coatings, for the reason that the coatings are partially solidified before contacting the paper stock.

We claim:

1. In the making of coated paper the process which comprises applying to the paper stock a layer of paper coating composition comprising an aqueous suspension of mineral filler and adhesive, drying said layer to produce a water absorptive layer of coating material, applying to the surface of said absorptive layer a second layer of coating composition comprising mineral filler and adhesive in aqueous suspension, thereafter contacting said second layer of coating composition with a finishing surface having a finish substantially the same as that desired on the coated paper and drying said second layer with its surface in contact with said finishing surface until the coating is no longer adherent to the finishing surface.

2. In the making of coated paper the process which comprises applying to the paper stock a layer of paper coating composition comprising mineral filler and adhesive, drying the coating, calendering the coated paper, applying a second

layer of coating composition comprising an adhesive and mineral filler in aqueous suspension to the surface of the first layer, thereafter contacting said second layer with a heated finishing surface and drying said second layer in contact with said finishing surface until the coating material is no longer adherent to the finishing surface.

3. The process of claim 1 wherein the inner layer of coating composition has a smooth surfaced finish and the outer layer is of a weight less than 2 pounds per 1000 square feet, dry basis.

4. Coated paper having two continuous superimposed layers of coating on one side, said paper being made by the process of claim 1, with the outer layer presenting a cast surface which is substantially free of minute and microscopic surface defects such as herein described.

5. Coated paper having two substantially continuous superimposed layers of coating material on one side, said paper being made by the process of claim 1, with the outer layer of an amount less than 2 pounds per 1000 square feet of surface, dry basis, and presenting a cast surface which is substantially free of minute and microscopic defects such as herein described.

6. Coated paper having two substantially continuous superimposed layers of coating on one side, the outer layer containing casein adhesive, said paper being made by the process of claim 1, with the outer layer presenting a cast surface which is substantially free of minute and microscopic surface defects such as herein described.

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