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METHOD OF COATING PAPER WITH HIGH SOLIDS HIGH VISCOSITY COATING IN THE WET END OF THE PAPER MAKING MACHINE

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This invention relates to improvements in the art of paper making and particularly to an improved method and means of applying a high solids content, high viscosity coating in the wet end of the paper making machine. As used herein, "coating" refers broadly to a suspension of: starch, casein or other adhesives; clay, pigment or minerals; and additives (generally the adhesives range from 15% to 20% and the minerals from 85% to 90% of the total solids dry); with respect to the coating "high solids content" means such content in the range of 40% to 60% or in excess of 50%; "high viscosity" means a viscosity of from 3,000 to 10,000 centipoises, or over 5,000 centipoises; "heavy coating" means coating having high solids content and high viscosity; "wet end coating" means coating which is applied to the web as the web passes through the press rolls in the press section of the paper making machine (such press rolls usually identified as the first, second, third, or reverse press, and fourth (or smoother where the web is unsupported by a felt); and "speed" means linear travel of the web and peripheral travel of a roll in feet per minute (f.p.m.).

In Muggleton Patent No. 2,772,604 there is pointed out the advantages to be derived from applying coating at the wet end. Some of such advantages are: (1) the web readily "takes" the coating and stretches rather than breaks under the strain; (2) a smoother surface paper is obtained; (3) an increase in strength of the web; and (4) increase in speed. However, it was found that in using the method of this patent the viscosity of the coating (which depends primarily on the condition of the starch constituent) could not exceed about 150 centipoises because of excessive turbulence at the metering nip. Thus it was impossible to attain the other advantages which may be had if the coating applied in the wet end has high solids content and high viscosity. Such other advantages are: (1) increase in the speed of an existing machine by increase of dryer capacity; (2) elimination of extra wetting, shrinking and drying occasioned by the applying of the coating at the dry end; (3) eliminating the tendency of the coating to yield to surface tension and be unequally distributed upon the coating roll surface; (4) doing away with undesirable pattern due to splitting; (5) minimizing film distortion as the coating is pressed against the rough surface of the web; (6) proper leveling out of the web due to increase in lubrication of the surface of the web; (7) obtaining even distribution; (8) preventing damaging contact between soft fibres of the web and the surface of the press roll; and (9) the application of substantial quantities of coating to lighter weight papers so as to be comparable with fully coated sheets.

There is today an increasing demand for paper of lighter weights per ream to provide more printed surface per unit of paper weight and save on postage and shipping costs. However, until this invention the making of paper of such lighter weights required much paper machine time and the manufacturing cost was unduly increased.

It is the object of this invention to obtain the foregoing advantages and provide a means for and method of applying high solids content high viscosity coating in desired quantities to the paper web to provide a uniform coated optimum printing surface free of commercially non-acceptable pattern or pebbly, cockled appearance.

This object is obtained by applying heavy coating to the web in the wet end of the paper making machine in the high solids content and high viscosity ranges set forth above. When the viscosities are within such range (as compared to viscosity range of 150 centipoises obtainable by using the method described in Patent No. 2,772,604) the difficulty of keeping out commercially non-acceptable pattern is eliminated and the other advantages enumerated above are obtained. With such high solids content high viscosities in the coating and greater 50% moisture content in the web there is a "squashing out and dispersion over wide areas in the fibrous web" and an elimination of the tendency of the coating to yield to surface tension and partly remain on the press or coating roll thus entirely eliminating splitting pattern. This application of such high solids content and high viscosity coating at the wet end sections promotes the leveling action of the presses (including the smoother) because the starch or binder of the coating provides proper lubricant enabling the adjustment of the fibres composing the web as the web passes through the presses. This also minimizes film distortion. The interposition of this coating containing clay and other pigments between the web and the press roll protects the method of this invention from crushing action of the press roll surface. The application of such high solids content coating lowers the moisture content of the web as it enters the dryer of the machine thus increasing the dryer capacity permitting increase in web speed.

Previous to this invention heavy coatings have not been successfully applied in the wet end. Apparently none of the skilled workers in this art had discovered how to prevent the disturbance, turbulence and splashing which took place in a metering nip of the kind shown in Muggleton Patent No. 2,772,604 when such coatings were supplied to such nip. Only a little splashing near the travelling web in the wet end will break it down. This prevented the application of such coating at the wet end. In accordance with this invention the small diameter applicator roll forming with the press roll a metering nip is individually driven so that the speed differential between the applicator roll and the coating roll can be controlled in accordance with varying conditions. When starting or when the nip is dry the speed of the applicator roll and the press roll is the same; i.e., the speed differential is practically nil. After the coating is supplied to the nip to form a pool or pond the surfaces of such rolls are lubricated and the speed of the applicator roll is reduced relative to the speed of the press roll to the point where the agitation, splashing and turbulence stops and the pond of coating material becomes smooth. Once this optimum speed differential is attained, the speed differential may be further adjusted to various differentials greater than the optimum to meter the desired quantity of coating to be applied to the press roll surface.

The novel features, which are considered characteristic of the invention, are set forth with particularity in the appended claims. The invention, together with additional objects and advantages thereof, will best be understood from the following description of a specific embodiment when read in connection with the accompanying drawings in which:

FIG. 1 is a diagrammatic view in side elevation of the wet end of a Fourdriner paper making machine showing the press rolls and applicator roll by which the method embodying this invention is carried out.

FIG. 2 is an enlarged fragmentary diagrammatic view in side elevation of the first press of said machine.

FIG. 3 is an enlarged diagrammatic view in perspective of the first press of said machine.
The web 10 is formed in the usual manner on the wire 12 of the paper making machine. Upon leaving the couch roll 14 the web is picked up by the felt 16 of the first press 18. After pasting and coating the press 18, the web is picked up by the felt 20 of the second press 22. At this press the web 10 being stronger may be carried over the tops of applicator rolls and again deposited on the felt 20. Thereafter the web is transferred to the felt 24 of the third or reversing press 26. As the web leaves the couch roll 14 and is received by the first press rolls 18, it has a water content of from 80% to 86% and a solids content of 14% to 20%, such solids content may be free of clay or other ash forming content.

At such consistency the web is able "to take" from the upper roll of the first press 18 a film or heavy coating which has a solids content in the range of 40% to 60% or in excess of 50% and a viscosity in the range of from 3,000 to 10,000 centipoises or over 5,000 centipoises. The web takes up such heavy coating from the coating roll 18 without a splitting pattern. Because of reduction in surface tension forces in such heavy coating, unequal distribution of the coating on such roll is eliminated. This high viscosity coating thoroughly lubricates the surface of the web permitting more leveling out of the fibers of the web and doing away with film distortion arising from pressing the coating on the rough paper surface. The particles of mineral pigments in the heavy coating being in intimate contact between the web and the surface of the press rolls 18 and tend to reduce the intimate contact between the soft fibers of the web and the surface of such press rolls thereby protecting the web against partial crushing.

To apply such heavy coating to the press roll or coating roll 18, a single smooth small diameter applicator roll 28 is mounted as shown adjacent the press roll 18 in bearings of customary design. Standard type actuating air cylinders (not shown) control the position of the roll 28 with respect to the press roll 18 so that in normal operation these rolls run in close contact under very little pressure. The air cylinders can vary this pressure as required and remove the roll 28 out of contact when coating is not to be applied. The applicator roll 28 is individually driven by a controlled electric motor diagrammatically illustrated at 29 so that the peripheral speed of such roller may be varied with respect to the peripheral speed of the press rolls 18 as hereinafter set forth in detail. The heavy coating material is supplied to the nip between the rolls 28 and 18 to form a supply pool 30 from a distributing manifold indicated generally at 32. Adjustable basins or catch boxes 34 of well known design placed at the ends of the rolls 28 and 18 control the height of the supply pool 30 and catch the overflow of the pool for recirculation in normal practice in this art.

Before any heavy coating is supplied to the nip between rolls 28 and 18 and before the roll 28 is brought into contact with the roll 18, its speed is controlled through motor 29 to have substantially the same speed in the same direction of peripheral travel at the nip as the roller 18. When this condition has been attained, the roll 28 is moved into light pressure contact with the roll 18. Thereafter the heavy coating may be supplied from the manifold 32 to the nip to form and continually maintain the pool 30. If such pool should become dry and at such time the roll 28 is not being rotated at the same speed as the roll 18, the roll 28 must be withdrawn from contact with roll 18 in order to prevent destruction to the surface of the rolls while in the dry state. After the pool 30 is established and the roll surfaces lubricated, the speed of the roller 28 may be lessened with respect to the speed of the rough roll 18 until all turbulence, splashing and disturbance of the coating in the pool is eliminated and the pool is calm. Once this condition has been attained, the differential speed between these two rollers may be further adjustably increased to meter the amount of the coating which is applied to the press or coating roll 18. It is been found that with the press roll 18 running at speeds of 785 to 790 f.p.m. the speed of the applicator roll for normal application will range from 150 to 250 f.p.m. When the viscosity of the heavy coating is increased the speed of the applicator roll 28 may need to be adjusted to maintain the pool 30 in a reasonably calm non-splashing condition.

As before stated, an advantage of applying a high solids content and high viscosity coating in the wet end of the paper making machine is that existing machines can be easily converted to employ this method and at the same time increase their capacity for making paper. The speed at which the web runs through many of such machines is usually limited by the capacity of the drying section. When the heavy coating is applied at the wet end, the moisture content of the web as it enters the dryer is automatically lowered because the solids content of the coating is in excess of the solids content of the web at the wet end. Since the moisture content of the web is now lower as the web enters the dryers less moisture need be evaporated and the machine speed can be increased. As an example a test of an existing machine operating at 575 f.p.m. while producing uncoated paper of standard basis weight of 100 per 24" x 36" (per each) at 45 lb. showed it evaporated 2.74 lb. of water per square foot of its dryer surface. However, when a similar web containing 30 lb. of raw stock plus 15 lb. of heavy coating added in the wet end having a 50% solids content was fed to its dryer with the same speed, only 2.30 lb. of water per square foot of its dryer surface was evaporated to produce the same end dryness (95%). This means an increase of drying capacity of about 19% or an increase of speed to about 685 f.p.m.

It is within the contemplation of this invention that the heavy coating may be added at the second press 22 by an applicator roll 28a or at a smoother press (not shown) where the web is not supported by a felt. The heavy coating material may also be applied to both sides of the web. This can be done by applicator rolls contacting both the upper and lower press rolls of the mother press or by applicator rolls 36 in the second press 22 or applicator rolls 38 and 40 in the reverse press 26.

Although but one embodiment of the invention is shown and described herein, it will be understood that this application is intended to cover such changes or modifications as come within the spirit of the invention or scope of the following claims.

I claim:

1. The method of applying heavy coating to a web of paper travelling through the wet end of a paper making machine having press rolls comprising, placing an adjustable speed controlled small diameter applicator roll in contact with the same speed or the overide press roll to furnish to said nip a supply of heavy coating having a viscosity in the range of 3,000 to 10,000 centipoises, and driving said applicator roll in the same peripheral direction at the nip as said press roll and at a speed sufficiently less than the speed of said press roll to maintain a calm non-splashing pond of coating at said nip.

2. The method as claimed in claim 1 in which said heavy coating has a solids content in the range of 40% to 60%.

3. The method as claimed in claim 1 in which said web has a moisture content in excess of 50% and said coating has a solids content in excess of 50% and a viscosity in excess of 5,000 centipoises.

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