

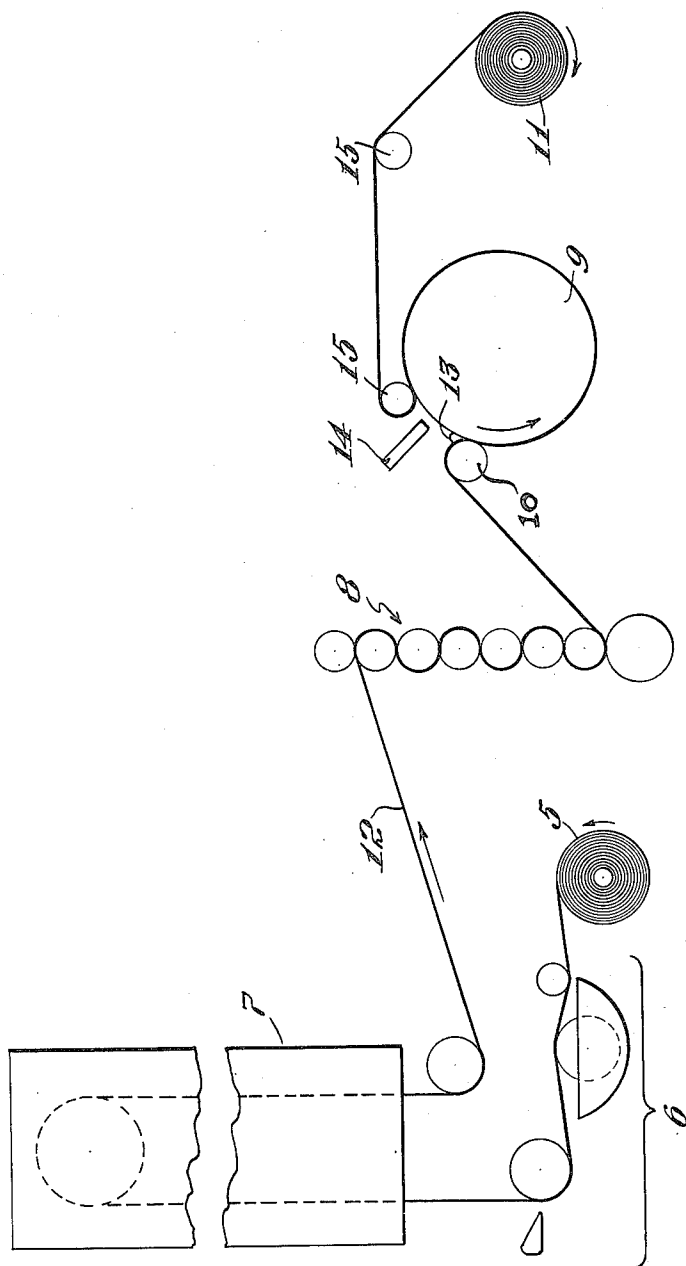
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METHOD OF CAST CALENDERING PAPER

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1

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METHOD OF CAST CALENDERING PAPER

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The present invention relates to coated paper and to methods for producing the same and particularly to coated paper having a high surface gloss or level, flat, smooth surface, or both and to methods for producing the same.

According to one prior process for producing such paper a travelling paper web is provided with a conventional coating comprising hydrophilic swellable adhesive. The travelling web of coated paper is then dried and may or may not be supercalendered. The dried coating surface of the travelling web is then wetted with water or aqueous solution and immediately pressed into adhesive contact with a heated, highly polished finishing surface, such as the surface of a highly polished chromium-plated cylindrical drum, and dried while in contact therewith. When applied to the finishing surface, the moistened coated surface adheres to the finishing surface, and after the coating has dried it is easily removed from contact with the finishing surface.

A preferred type of hydrophilic swellable adhesive for use in the above process comprises hydrophilic swellable proteins such as casein. When casein is used it is first rendered water soluble or cut by treatment with an alkali-metal compound such as sodium hydroxide or ammonia to form water-soluble mono- or poly-ammonium or alkali metal caseinates which are then applied in aqueous solution to the paper as a constituent of the coating composition.

It has been found that in such processes in order to obtain satisfactory results the pH of the coating surface when pressed into adhesive contact with the drum should be between about 7.3 and about 9.0. If the pH is higher than about 9.0 the coating surface will stick to the finishing surface after drying so that the paper will not come off the finishing surface without tearing or injuring the coating surface unless substantial amounts of release agents such as certain soaps and oils are used in which case, satisfactory gloss is often not obtained because of the mottling effect of such soap and/or oil. If the pH is lower than about 7.3 the coating surface will not adhere to the drum surface with sufficient tenacity to give satisfactory results.

The pH of the coating surface when pressed against the drum surface depends upon the amount of alkali-metal compound or ammonia present in the coating surface at that time and the pH of the aqueous wetting liquid.

With the use of either alkali-metal compounds or ammonia the quality of the finished product varies greatly with slight variations in operating conditions thereby making the process very difficult to control satisfactorily under plant conditions.

In the case of alkali-metal compounds, they are of such high basicity that slight variations in operating conditions or of the amounts of such alkali metal compounds, which are very difficult to prevent during operation in the plant, are liable to raise the pH of the coated surface

2

well above 9.0 with resultant sticking of the coated surface to the drum surface when dry.

In the case of ammonia, it is so volatile that a large portion originally utilized to cut the casein is volatilized from the coating during drying so that the pH of the coated surface by the time it is wetted and pressed against the finishing surface is below about 7.3 and hence will not adhere to the drum surface with sufficient tenacity and uniformity to yield a satisfactory product. Although the pH and hence degree of adhesion of the wet coated surface can be increased by inclusion of ammonia in the aqueous liquid used to wet the surface, the degree of increase fluctuates widely during plant operation due to slight uncontrollable variations in operating conditions affecting the volatility of the ammonia, and it is necessary in many cases, in order to achieve satisfactory subsequent release, to utilize a release agent such as soap and/or oil in the aqueous liquid along with the ammonia.

Furthermore, the final finished coating surface is still not wet-rub resistant when removed from the drum surface. By wet-rub resistant it is meant that coating will not be removed from the coating surface when rubbed with a wet finger. Even when formaldehyde is mixed with the moistening liquid for the purpose of reacting with the casein in the coating surface to insolubilize the same and thereby render it wet-rub resistant, the formaldehyde-casein reaction is so slow under the operating conditions necessarily accompanying the use of ammonia in admixture with the aqueous liquid, that even when considerable amounts of formaldehyde are used it takes many hours before the finished surface is sufficiently insoluble to be wet-rub resistant.

Even when surface pH's of between 7.3 and 9.0 are maintained in many cases it is necessary in order to obtain consistently satisfactory release during plant operation to utilize a release agent in the aqueous liquid. The only release agents known heretofore are certain types of soaps and oils. However, in using soap and oils it is very difficult to control the proper quantities required for release during plant operation and thereby to prevent small excesses which cause mottling of the coated surface.

One of the objects of the present invention is to provide a process of the above type wherein the quality of the finished product is not affected to any great extent by slight variations in uncontrollable operating conditions.

A second object of the present invention is to provide a novel manner of obtaining consistently excellent release during operation under plant conditions without the use of soaps and oils with their accompanying disadvantages.

A third object of the present invention is to render the coating surface wet-rub resistant by the same mechanism which provides the above mentioned release and simultaneously therewith so that the coating surface is wet-rub resistant when removed from contact with the drum surface.

A fourth object of the present invention is to provide a process wherein the quality of the finished product is not sensitive to slight uncontrollable variations in operating conditions and wherein at the same time consistently excellent release from the drum surface of a wet-rub resistant coated surface is attained during operation under plant conditions without the use of soaps or oils with their attendant disadvantages.

The first object mentioned above is attained in accordance with the present invention by using in the aqueous coating composition and/or in admixture with the aqueous liquid a basic nitrogen containing organic compound e. g. an amine, having a boiling point above about 125°

3

C., preferably above 150° C., and a basic ionization constant (K_b) between about 10^{-3} and 10^{-7} preferably between 10^{-4} and 10^{-6} . A sufficient amount of such organic compound is used either to cut the casein and/or in admixture with the aqueous liquid to maintain the pH of the finished coating surface between about 7.3 and about 9.0, preferably between about 7.5 and 8.0.

Surface pH is measured by placing three drops of distilled water upon the surface of the coating and immediately thereafter adding a drop of indicator solution thereto. The mixture is then agitated slightly and the resultant color compared after 5 seconds time with the standard La Motte color tubes for the particular indicator being used.

The other objects mentioned above are attained by using the nitrogen compounds of the present invention as indicated above, and in conjunction therewith, contacting the wetted coating surface before the same is pressed into contact with said drum with formaldehyde in the proper amounts to be later described. Preferably the formaldehyde is admixed with the aqueous agent.

A possible explanation of the fact that consistently excellent release of a set-up surface is attained with the use of the nitrogen compounds of the present invention in the manner and quantity indicated is that conditions exist at the coating surface during the finishing operation which bring about relatively fast reaction rates between the formaldehyde and the water soluble casein adhesive in the coating surface to form insolubilized casein products. These relatively fast reaction rates cause sufficient reaction to occur during the short time between the initial application of liquid and the removal of the coating surface from the drum to produce an insolubilized wet-rub resistant coating surface which is easily released from contact with the drum surface without the use of any release agents such as oil or soap. It is believed that this is an entirely new and novel manner of obtaining release.

Particular basic nitrogen-containing compounds which have been found most suitable for use in accordance with the present invention comprise one of the group consisting of an alkanolamine, a polyalkylene polyamine, and mixtures of the same. Monethanolamine is preferred. Examples of other alkanolamines which are suitable for use in the present invention are: mixed isopropanolamines, diethanolamine, triethanolamine, N-ethyl ethanolamine, and any other watersoluble alkyl-alkanolamine having the proper boiling point and basicity. Examples of polyalkylene polyamines are: diethylene triamine, triethylene tetramine, N-hydroxyethyl propylene diamine, tetraethylene pentamine, and any other water-soluble alkyl and hydroxyalkyl alkylene and polyalkylene polyamines having the proper boiling point and basicity.

Other basic nitrogen containing compounds suitable for use in the present invention are trimethyl benzyl ammonium hydroxide, morpholine, and tetraethanolammonium hydroxide.

Preferably the nitrogen-containing compounds of the present invention are substantially odorless and colorless, but this is not always essential.

Fig. 1 of the accompanying drawing discloses one particular embodiment of the preferred type of apparatus suitable for carrying out the processes of the present invention.

Referring to Fig. 1, 5 is a feed roller for the paper body stock, 6 is a conventional air-knife coating unit, 7 is a drier, 8 a supercalender, 9 a revolving molding drum having a smooth, highly polished, mirror-like, chromium surface and a means for heating such surface (not shown), 10 a pressure roll (preferably having a yielding surface as of rubber or felt), 14 a source of aqueous liquid such as a series of spray nozzles for spraying aqueous liquid onto the surface of drum 9 along its entire length, from whence such liquid flows into the nip formed by the paper web on pressure roller 10 and molding drum

4

9 to form a pool of liquid 13 in such nip, 15 are take-off rollers for removing the paper from the surface of drum 9, 11 a wind-up roller, and 12 the paper web. The surface of pressure roll 10 is urged against the surface of drum 9 by any known means such as a spring (not shown).

The movement of the paper through the apparatus from the feed roller 5 to the windup roller 11 is indicated by arrows.

According to one preferred manner of carrying out the processes of the present invention, a coating composition is formed, one of the ingredients of which is a product obtained by mixing a hydrophilic swellable protein, such as casein, with water and one of the above mentioned organic basic nitrogen-containing compounds. Sufficient amounts of organic compound are used to render the casein water-soluble, as well as to maintain the pH of the coating composition between about 7.5 and about 10, preferably between about 8.0 and about 9.0. This coating composition is then applied to a traveling web of paper by air-knife coating unit 6, or, any other type of apparatus for applying coating to traveling paper webs, and subsequently dried, by passage through drier 7 or any other type of drier. The dried coated surface may, or may not, then be supercalendered. Preferably, in carrying out the present invention, the dry coated surface is supercalendered by passage through supercalender 8. The hard, dry, supercalendered coated surface is then subjected to a surface finishing operation, whereby it is carried by press roll 10 through a pool of aqueous liquid 13 in the nip formed by the surfaces of press roll 10 and drum 9. The aqueous liquid contains formaldehyde in an amount to be later discussed. The surface of the coating is wetted by passage through the pool of aqueous liquid 13 in the nip. The surface of the drum 9 revolves through and is also wetted by the pool of aqueous liquid 13 in the nip. The wet surface of the coating is then immediately pressed by press roll 10 against the wet surface of drum 9 with which it is kept in contact while moisture is being removed by evaporation and thereafter removed. The surface of drum 9 is not only wet by revolving the same through pool 13 immediately before the wet coated surface is pressed against it but also by the flow of liquid directed there-against from source 14.

According to yet another manner of carrying out the process of the present invention the casein is cut with ammonia alone or ammonia and organic nitrogen-containing compounds and the organic nitrogen-containing compounds are dissolved in the aqueous moistening liquid in sufficient amounts to insure proper adhesion of the coating surface to the finished drum when pressed there-against and to maintain the surface pH of the final finished coated product between about 7.3 and about 9.0.

In either of the above processes, if desired, soap or oil may be substituted for the formaldehyde to give release.

The proper amounts of formaldehyde to produce consistently a high gloss insolubilized, wet-rub resistant coating surface vary in accordance with the particular operating conditions used, as for instance, the temperature of the drum, the speed of the paper web, the amount of casein in the coating and the particular surface pH of the coating. In any particular operating condition, an amount of aldehyde should be used sufficient to consistently effect clean separation of the dried coating from the finishing or drum surface but insufficient to prevent the wetted coating surface from adhesion to the finishing drum surface when pressed into contact therewith. Although it is difficult to describe quantitatively the proper amounts of formaldehyde since it varies so greatly with the particular operating conditions in the plant, the operator during plant operation can easily determine the proper amounts of formaldehyde to be added by observing the paper being removed from the finishing surface. If, during plant operation, he observes the beginning of improper

release, more formaldehyde should be added. On the other hand, if he observes that the gloss of the finished paper is too low, this indicates insufficient adhesion of the wetted coated surface to the drum surface and the concentration of formaldehyde in the nip solution should be reduced.

Also, the operator can determine the proper amounts of formaldehyde to be utilized by rubbing the paper surface with a wet finger to determine its wet-rub resistance. If it is not wet-rub resistant, more formaldehyde must be added. Usually the amounts of formaldehyde (37% commercial Formalin) suitable for use with the present invention vary from about ½% to about 5% and preferably from about ½% to about 2% by weight of the aqueous moistening solution. However, these limits are not exact and the present invention is not intended to be limited thereby since, as stated above, the proper amounts of formaldehyde vary greatly according to operating conditions.

Proper amounts of organic nitrogen-containing compounds also vary in accordance with the particular operating conditions.

It is preferred practice to use all of the organic nitrogen-containing compounds in the aqueous coating composition without adding any to the aqueous liquid. In such case it is preferred to use sufficient amounts of organic nitrogen-containing compound to both dissolve the casein and maintain the pH of the coating composition between about 7.5 and 10 or the pH of the finished coating surface, when removed from the finishing surface, between about 7.3 and about 9.0. However, if desired, the casein may be dissolved with ammonia and/or ammonia and organic nitrogen-containing compound, and sufficient organic nitrogen-containing compound added to the aqueous coating composition to maintain the proper pH.

When the nitrogen-containing compound is used as the sole casein solvent, which is the preferred practice, the quantity necessary to dissolve the casein will depend upon both the molecular weight of the said compound and the number of basic nitrogen groups present per molecule. Generally speaking, the required quantity for casein solution purposes will amount to from about 5% to about 20% of the weight of the casein.

When the organic nitrogen-containing compound is added with the aqueous liquid the amount is regulated to consistently maintain the surface pH of the finished coating surface between about 7.3 and about 9.0. In such cases, when formaldehyde is used in the aqueous solution, the amounts of nitrogen compound and the amounts of formaldehyde should be balanced in response to visual observation on the part of the operator as mentioned above, to maintain the proper pH, release and gloss.

In accordance with the present invention, finishing surface temperatures of from about 160° F. to about 210° F. may be used. However, temperatures of from about 170° F. to about 200° F. are more suitable, and temperatures from about 175° F. to about 190° F. are preferred. However, care must be taken that no steam bubbles or blisters form in or immediately adjacent to the nip for such bubbles may break the contact of the coating surface with the drum and effectively prevent development of the desired glossy surface in such areas. Nevertheless it is possible to use higher temperatures for the drying operation, provided the surface of the drum is cooled well below steam temperature at the spot immediately before the pressure nip at which the coated paper makes contact with said surface.

The normal operating paper speeds, in accordance with the present invention, lie within the range of 80 to 250 ft. per minute. The speed will in part depend upon the diameter of the drum being used.

Whether formaldehyde is used or not the use of nitrogen compounds of the present invention results in a process wherein the quality of the finished product is not affected

to any great extent by slight variations in uncontrollable operating conditions.

The finished coated paper made according to the process of the invention consistently has a printing fidelity exceeding that of any previously known high quality supercalendered coated paper such as No. 1 glossy-coated printing papers of commerce.

The specular gloss values of papers embodying the present invention may be measured by a Scott-Aminco goniphotometer manufactured by the American Instrument Company of Silver Spring, Maryland. In making the tests, the sample is illuminated by a beam of light making an angle of 70° from normal to the sample surface, and the reflected light measured is at an angle also 70° to the normal to the paper surface but on the opposite side of the normal, so that if the illumination were at plus 70° the reflected light would be at a minus 70° to the normal. The reflected light is passed through a lens and then through a slit aperture placed at a focal distance from the lens. The slit subtends an angle of 1° 38' in the plane of light beam and an angle of 5° 2' across the plane of the beam, the angles being from the optical center of the lens. The numerical figures so obtained for specular gloss are in percentages of the light reflected from a highly polished flat black plate glass standard.

Measurements made as described upon usual supercalendered glossy-coated printing papers of the quality at present sold as No. 1 quality glossy-coated printing papers usually yield values of specular gloss between 10 and 15. Especially severe supercalendering may yield papers having specular gloss values of about 20. Never, so far as we know, do supercalendered coated papers have a specular gloss as high as 25. On the other hand, the product of the present invention consistently during continuous operation, has a specular gloss, measured as described, of at least 30, and preferably of about 35 or above. Most samples consistently fall between 35 and 60 specular gloss, and frequently specular gloss values over 60 are reached.

In practicing the present invention, the proper quantities of aqueous liquid which should be used vary in accordance with the particular type of coatings and other operating conditions. Quantities varying from about 3 gallons to about 10 gallons, preferably from about 4 gallons to about 7 gallons, per 1000 sq. ft. of coating surface may be used, but the invention is not limited to such amounts.

When the apparatus of Fig. 1 is utilized, it is preferred to feed the aqueous liquid to the nip at a good flow rate so that a pool of about one to two inches in depth is maintained in the nip between the paper and the finishing drum, with the overflow running to the sewer at each end of the nip.

Although the present invention is most suitable for use with a casein adhesive, it is also applicable for use with other protein adhesives which have to be dissolved with an alkali.

The present invention is preferably applicable for use with mineral coatings applied to paper in the form of aqueous compositions comprising adhesives such as casein or soy protein, and mineral pigments such as clay, blanc fixe, calcium carbonate, talc, titanium dioxide, ultramarine or the like. Part of the adhesive may be other known adhesive compounds such as synthetic elastomers, glue, starch, polyvinyl alcohol, etc. An example of a suitable elastomer is synthetic rubber latex. However, the present invention is also applicable for use with other types of coatings normally applied to paper, including coatings comprising only water swellable proteins such as casein. Such latter coatings are usually applied to paper already having a first coating.

The present invention is applicable to and includes within its scope processes wherein the coating surface is removed from contact with the highly polished finishing surface before or after drying is substantially completed

and with or without an oil and/or soap film over the drum surface.

The present invention is also applicable to and includes within its scope processes wherein the freshly applied coating, while still wet and before substantial drying, is pressed against a highly polished finishing surface, including processes wherein a wet coating is applied to the paper web in the nip formed by the finishing surface and the paper web as carried by the press roll. In such processes, except for processes in which the coating is applied in the nip, there may or may not be a wetting step, depending on the degree of wetness of the coating when pressed against the finishing surface. Such processes are described in United States Patents Nos. 2,316,202 and 1,719,166.

When the coating composition is applied to the paper web before the finishing operation and the freshly applied coating, while still wet, is thereafter pressed against the finishing surface, whether or not another wetting step is included, a formaldehyde vapor or solution may be contacted with the freshly applied coating surface immediately before it is pressed against the finishing surface in order to aid in obtaining the proper release and an insolubilized, wet rub resistant finished coating surface. However, when the coating is applied in the nip, this is not practical and other means for insolubilizing the coating surface must be used.

Example 1

Twenty pounds of casein was stirred with 100 pounds water at 160° F. for 20 minutes. To this was then added one pound of monoethanolamine and agitation was continued until the casein was dissolved. The dissolved casein was then thoroughly mixed with an aqueous dispersion of clay 60 pounds, calcium carbonate 40 pounds, vegetal 1 pound, tributyl phosphate ¼ pound, and sufficient water to make the solids content 40%. The pH of this coating composition was about 8.6. This coating composition was then applied by a conventional air-knife coater to one side of a suitable paper base stock in quantity equal to about 5 pounds per 1000 square feet, and the so coated paper was then dried and supercalendered. The surface pH of the supercalendered coated paper was about 8. The supercalendered surface was then roll pressed against a heated polished finishing drum while the nip between the drum and the coated paper surface was kept filled to the depth of about 1¼ inches with an aqueous solution of formaldehyde containing about 0.35% anhydrous formaldehyde. The flow rate of the formaldehyde solution to the nip was about 4.4 gallons per 1000 square feet of coated paper surface, with at least 90% overflowing to the sewer. The drum temperature was maintained at about 180° F. and the speed of operation was about 100 feet per minute. The release of the dried coated paper from the drum surface was consistently excellent during plant operation. The resulting product consistently had a uniformly attractive surface showing a gloss reading on the Scott-Aminco goniophotometer of 50. The surface was satisfactorily wet-rub resistant and when printed it gave superlative results in respect to fidelity.

Example 2

In another example the procedure of Example 1 was repeated with the exception that the casein was dissolved by ammonia water instead of by monoethanolamine and after the coating composition was otherwise complete, 0.7 pound of monoethanolamine was added to the mixture. The results obtained were not observably different from those given in Example 1.

Example 3

Another coating composition was prepared similar to that of Example 2 except that all monoethanolamine was omitted from the composition. Paper was coated

therewith, dried and supercalendered. The supercalendered surface was pressed against a heated chromium plated drum while the nip between the drum and the coated paper was kept flooded with an aqueous liquid containing 0.25% monoethanolamine and 0.5% formaldehyde. The resulting product released readily from the drum with an unblemished surface of high gloss, and it was satisfactorily wet-rub resistant.

Example 4

Example 3 was repeated except that the nip between the coated surface and the chromium plated drum was kept flooded with an aqueous liquid containing 0.25% of monoethanolamine and 0.20% of monoethanolammonium stearate. The finished product was not wet-rub resistant, but otherwise was not observably different from that of Example 3.

Example 5

A paper body stock of approximately 89 pounds per ream was made from a paper making furnish containing in addition to fibers pregelatinized starch, soluble dyestuffs, and soda ash. To each side of the dry web so produced a surface filling was applied on the paper machine in the amount of 1.2 pounds dry weight per 1000 square feet from a composition comprising the following:

	Lbs.
Clay	about 1500
Converted starch	about 450
Non-oleaginous dyestuff	5½
Fungicide (e. g. Dovicide)	2
Water to make a solids content of about 21% by weight.	

This base stock was then calendered on the paper machine calenders.

To this surface-filled base stock was then applied to both sides, on a coating machine the following coating composition, having a pH value of about 8.2 and in the amount of about 4.1 pounds, dry weight, per thousand square feet per side:

	Lbs.
Clay, dry basis	60
Calcium carbonate	40
Casein, dry basis, dissolved by monoethanolamine	19.5
Non-oleaginous dyestuff (dry basis)	0.1904
Tri-butyl phosphate	0.5

The paper was then dried and calendered on a supercalender at a pressure of about 1800 lbs. per linear inch at the bottom nip.

The paper was then run through a finishing machine like that illustrated in the drawings having a highly polished drum or roll 9 against which the paper was pressed by the press roll 10 at the nip of which with the drum the paper was wet by the application of an aqueous nip solution containing formaldehyde as its only ingredient. The nip solution contained about 0.06 pound of formaldehyde (dry basis) to each gallon of water. The drum was maintained at between 180° and 195° and was run at a speed of about 100 feet per minute. The nip solution was continuously fed at the rate of about 14½ gallons per ream of paper and it had a pH value of about 6.7.

The results obtained were not observably different from those given in Example 1.

Although from considerations of cost and general convenience monoethanolamine is the preferred alkaline nitrogen-containing organic compound for use according to the invention, very similar results may be achieved by substitution therefor in any of the preceding examples of an equivalent combining weight of any other of the alkaline nitrogen-containing organic compounds previously mentioned as being useful.

It is believed that in carrying out the preferred method of this invention a thin film or layer of aqueous liq-

liquid is formed on the surface of the finishing roll 9 as the coated paper passes through the nip of the press roll surface 10 and the finishing roll surface. Hence it is believed that the wetted surface of the coating after passage through the nip pool of aqueous liquid is pressed against a thin film or layer of aqueous liquid on the drum surface and as the paper revolves with the hot drum surface water from both said aqueous liquid in the film and the wetted coating surface is evaporated and passes through the paper as vapor. The terms "maintaining the surface of the coating in contact with," "pressing a coating surface against," "pressing the wet coating surface against" and "maintaining the coating in contact with" a polished surface, polished finishing surface, finishing surface, heated surface, and the surface of the finishing roll as used in the specification and claims include contact with or pressing against such a surface which carries a film or layer of the aqueous liquid which is supplied to the nip of the press and the finishing rolls.

Although it has been attempted to explain the theory of the present invention it is not intended that the present invention be limited to such theory.

It should be understood that the present disclosure is for the purpose of illustration only and the present invention includes all modifications and equivalents which fall within the scope of the appended claims.

I claim:

1. In a process for producing a coated paper having a level surface, comprising applying aqueous liquid to a dry coating surface of a coated paper, the coating of such paper comprising a hydrophilic swellable protein, to wet said dry coating surface and immediately thereafter pressing said wetted coating surface against a highly polished, smooth, finishing surface with which said wetted coating surface is kept in contact while moisture is evaporated therefrom and thereafter removed, the improvement comprising contacting said wetted coating surface, before it is pressed against said finishing surface, with formaldehyde, and maintaining the surface of the coating in contact with the finishing surface while the pH of the surface of the coating is maintained between 7.3 and 9 by the presence of a member of the group consisting of amines and quaternary ammonium hydroxides having a boiling point above about 125° C. and a basic ionization constant between about 10^{-3} and 10^{-7} and until the time when the coated surface is removed from contact with the finishing surface.

2. The process of claim 1 wherein said formaldehyde is admixed with said aqueous liquid.

3. A process for producing a coated paper having a level surface comprising pressing a coating surface of a coated paper which is wet with aqueous liquid against a smooth highly polished finishing surface, said surface of said paper comprising a reaction product of a hydrophilic, swellable protein and an amount of a water soluble amine having a boiling point above about 150° C. and a basic ionization constant of between about 10^{-3} and about 10^{-7} sufficient to maintain the pH of the finished surface of the coating within the range from about 7.3 to about 9.

4. The process of claim 3, wherein said protein is casein and wherein said amine is one of the group consisting of an alkanolamine and a polyalkylene polyamine.

5. The process of claim 4 wherein said amine is monoethanolamine.

6. A process for producing a coated paper having a level surface, comprising applying aqueous liquid to the surface of a dry, hydrophilic swellable protein-containing coating of a coated paper in the presence of a water soluble amine having a boiling point above about 150° C., and a basicity constant between about 10^{-3} and about 10^{-7} in quantity sufficient to maintain the pH of the finished surface of the coating within the range from about 7.3 to about 9, immediately thereafter pressing the wetted surface of the coating against a smooth, highly polished finishing surface and maintaining it in contact

therewith while moisture is evaporated therefrom and thereafter removing the coated paper from said finishing surface.

7. The process of claim 6 wherein said protein is casein and wherein said amine is one of the group consisting of an alkanolamine and a polyalkylene polyamine.

8. The process of claim 7 wherein said amine is monoethanolamine.

9. The process of claim 6, comprising forming a coating composition, one of the ingredients of which is a product obtained by mixing a water swellable adhesive protein with water and said water soluble amine, applying said coating composition to a sheet of paper, thereafter drying the resulting coated paper, contacting the surface of the dried coating with an aqueous liquid to wet the same and immediately thereafter pressing said wetted surface against a smooth, polished finishing surface.

10. The process of claim 9 wherein said protein is casein and wherein said amine is one of the group consisting of an alkanolamine and a polyalkylene polyamine.

11. The process of claim 10 wherein said amine is an alkanolamine.

12. The process of claim 11 wherein said alkanolamine is monoethanolamine.

13. The process of claim 9, wherein, before said wetted coating surface is pressed against said finishing surface, it is contacted with formaldehyde.

14. The process of claim 13, wherein said formaldehyde is admixed with said aqueous liquid in an amount sufficient to effect clean separation of the dried coating from the finishing surface, but in an amount insufficient to prevent said wetted surface of the coating from adhering to said finishing surface when pressed into contact therewith.

15. The process of claim 14 wherein said protein is casein and wherein said amine is one of the group consisting of an alkanolamine and a polyalkylene amine.

16. The process of claim 15 wherein said amine is an alkanolamine.

17. The process of claim 16 wherein said amine is monoethanolamine.

18. The process of claim 6 wherein said amine is admixed with said aqueous liquid.

19. The process of claim 18 wherein said protein is casein and said amine is one of the group consisting of an alkanolamine and a polyalkylene polyamine.

20. The process of claim 19 wherein said amine is monoethanolamine.

21. The process of claim 18 wherein, before said wetted surface of the coating is pressed against said finishing surface, the surface of the coating is contacted with formaldehyde.

22. The process of claim 21 wherein said formaldehyde is admixed with said aqueous liquid in an amount sufficient to effect clean separation of the dried coating from the finishing surface, but in an amount insufficient to prevent said wetted coating from adhering to said finishing surface when pressed into contact therewith.

23. The process of claim 22 wherein said protein is casein and said amine is one of the group consisting of an alkanolamine and a polyalkylene polyamine.

24. The process of claim 23 wherein said alkanolamine is monoethanolamine.

25. The method of making high gloss paper which comprises making an aqueous coating composition having a pH of from 7 to 10 and comprising mineral filler, casein dissolved by monoethanolamine, tributyl phosphate and water, coating paper with the said composition, drying the coated paper, wetting the surface by the application of a nip solution of water and formaldehyde, and immediately thereafter pressing the coating surface against the polished surface of a heated drum.

26. The method of claim 25 in which the mineral filler is clay and calcium carbonate.

11

27. The method of claim 25 in which the paper coated is a surface filled paper.

28. The method of claim 25 in which the paper is maintained in contact with a heated drum until the casein is set by the formaldehyde and consequently released from the drum.

29. The method of claim 25 in which the coated paper is super-calendered before wetting.

30. The method of producing coated paper, the coating of which contains a hydrophilic swellable protein, which includes applying formaldehyde to the coating, which coating has a pH of between 7.3 and 9.0 due to the presence in the coating of a non-volatile, water-soluble amine, and maintaining the coating in contact with the

12

heated surface until the coating is set by reaction with the formaldehyde.

31. The method of claim 30 in which the amine is monoethanolamine.

32. The method of claim 30 in which the protein is casein.

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