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PROCESS FOR COMBINING CLOTH AND PAPER

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This invention relates to combined cloth and paper products, and a method for the preparation thereof.

It is often desirable for some purposes to have a material with a smooth paper surface and which also has a high resistance to tear and puncture. For this purpose it is common practice to combine by means of an adhesive a sheet of cloth with a sheet of paper, to form a product having the desirable properties of both materials.

In such a product the bond between the paper and cloth must be very firm. It is important that the combining adhesive used should give a tough film of very high bonding strength. It is also important that a firm bond be obtained notwithstanding the unfavorable bonding conditions prevailing such as, for example, the uneven and irregular contact of the paper surface with the rough and uneven surface of the cloth. These conditions make difficult the obtaining of a satisfactory bonding operation and product.

It is a well known fact in the case of paper and cloth combinations that the firmer and more brittle the bond between the cloth and the paper the less the tear resistance of the combination becomes. As high tear resistance is one of the desirable characteristics of a product of this type, it is highly desirable that the adhesive used should be a bond of high strength, and also be sufficiently tough and flexible so that the tear strength is satisfactory.

In addition to the above enumerated factors, it is also desirable that the adhesive be of such composition that it does not cause shrinkage of the cloth during the process of combining it with the paper. Cloth shrinkage causes the paper of the finished combined sheet to warp or wrinkle and also decreases the yield of the product.

Up to the present time, animal glue has been the only adhesive used for this purpose but it has long been appreciated that it is not satisfactory in all respects.

Many unsuccessful attempts have been made to use starch and dextrine adhesives for this purpose. Dextrine adhesives, although perfectly satisfactory for paper to paper combinations, do not give a bonding film of sufficient strength for this cloth and paper combination. The bonding strength of the cooked starches and modified starches is superior to that of the more highly soluble dextrines, but because of the necessity of using large proportions of water with them (the purpose is to reduce the starch viscosity sufficiently to permit easy application), their use gives rise to shrinkage and drying problems in the final paper-cloth product.

The usual procedure in combining cloth and paper is to apply the adhesive to the paper by means of rotating rolls, after which it is brought in contact with the cloth sheet. The combined sheets are then passed over heated drums or through a heated drying tunnel or both, to dry the adhesive and form the bond.

One of the objects of this invention is to provide a new and improved process of combining cloth and paper. A further object is to provide new and improved combinations of cloth and paper. Other objects will appear hereinafter.

We have found the prior difficulties may be avoided by a process utilizing in the bonding operation a major proportion of the starch in an ungelatinized and non-adhesive form, carried in a state of permanent suspension by means of a gelatinized starch or starch derivative hydrosol sufficiently viscous to prevent settling out of the ungelatinized starch, yet sufficiently liquid to allow the mixture to be picked up and applied to the paper by means of rotating rolls. By this means we are able to apply in a minimum volume of material a high concentration of starch with a relatively low proportion of water.

It will be apparent that the composition as applied to the paper will be of a relatively non-adhesive nature because it is substantially composed of ungelatinized starch, which in this state has no agglutinant properties. It is, therefore, necessary that the potential adhesive composition be subjected to a heating step after it has been applied to the paper and the cloth brought into contact, in order to gelatinize the ungelatinized starch component of the adhesive composition and thus form an effective bond.

This process solves the problem of excessive shrinkage of the cloth because only minimum proportions of moisture are present in the potential bonding agent as applied and the process does not involve as a primary feature the drying of the sheet but rather the conversion in situ of the inert starch which takes up water rapidly. Also the desirable bonding strength is obtained because of the fact that the potential bonding agent upon conversion in our process dries to a tougher and less brittle film than do dextrines. Also the mixture having a relatively low pressure of water results in a bonding film which does not tend to shrink away from the imbedded cloth fibers on drying.

The step in our process, of converting a non-adhesive substance to an effective bonding agent

by heat, is an important phase in the combining process. This step can be practiced in several different ways depending upon the several manufacturing factors involved.

One method of operation is to apply the above described potential adhesive composition to the paper by means of rolls and then immediately pass the coated side of the paper over a steam jet or through a steam chamber in such a manner that the potential bonding agent comes in contact with an atmosphere of wet steam. The rate of passage through the atmosphere of wet steam is regulated so that when the sheet emerges the ungelatinized starch component of the applied coating will have been converted to a completely gelatinized state, and assumed decided agglutinant characteristics. The paper sheet is then immediately brought in contact with the cloth under ordinary pressure. The combined sheet is then completely dried by passing over heated rolls and/or through a drying tunnel.

A second method of operation is to apply the described inert starch composition to the paper sheet by means of rolls and then immediately bring the coated paper surface into contact with the cloth sheet and pass the two sheets while in contact around a heated cylinder at such a rate as to convert the ungelatinized starch component of the potential adhesive to a gelatinized state in situ, and thus give it agglutinant characteristics. The combined sheet is then completely dried by passing it over heated rolls or through a drying tunnel or both.

Because of the heating conditions involved, it is necessary for the most satisfactory results to use for the ungelatinized starch component of the adhesive composition, only such starches as gelatinize readily at relatively low temperatures. Such starches as tapioca and potato have this property as a natural characteristic. Such a condition is not usually present in the formation of a bond between two paper surfaces, because the closed structure of both surfaces in such a case would confine the steam and moisture, result in higher temperatures at the bonding zone and create a situation favorable for the gelatinization of any type of starch applied in such zone. In the case of paper and cloth combinations, however, the relatively open structure of the cloth allows the steam and moisture to escape from the adhesive composition so rapidly that the ungelatinized starch component may not be completely gelatinized unless starches suitable for gelatinization at the temperatures prevailing at the bonding zone are used or unless sufficient heat is applied at the bonding zone to cause conversion irrespective of gelatinization temperature. The gelatinization temperature of the starch may be modified and lowered to a degree sufficient to permit conversion at relatively low temperatures by the addition of an agent to the potential adhesive such as urea, that acts to lower the gelatinization temperature of the inert starch. The action of such a modifying agent on a starch, such as corn starch, having a relatively high gelatinization temperature, permits its use as the equivalent of a relatively low temperature gelatinizing starch such as tapioca or potato. It is, of course, possible to use relatively high temperature gelatinizing starches without modification provided sufficient heat is applied at the bonding surface such as by the direct application of heat, for example, with steam, as in the first method described herein.

We have found that for certain purposes it may be desirable to use as addition agents certain materials such as clay, chalk, talc, and similar fillers. Also certain materials such as urea, glycerine, or latex may be utilized to render the final adhesive film more plastic or flexible.

For purpose of illustration, we set forth below several examples of the potential adhesive compositions of a type suitable for use in our process.

Example I

Twenty (20) parts of pregelatinized tapioca starch, such as is made by the well known hot roll process, is blended with one hundred and fifty (150) parts of raw ungelatinized tapioca starch. The above blend is then mixed with three hundred (300) parts of cold water and agitated until a smooth fluid paste free from lumps is obtained. The adhesive composition is then ready for use in the manner described above.

In this procedure the pregelatinized tapioca starch dissolves in the water to form a gelatinized starch hydrosol which carries the ungelatinized raw tapioca starch in suspension and imparts sufficient viscosity to the mixture to enable it to be picked up and applied to the paper by means of rotating rolls.

Example II

Twenty (20) parts of urea and twenty (20) parts of slightly dextrinized tapioca or corn starch are cooked with seventy-five (75) parts of water at substantially 190° F. so as to form a viscous hydrosol. In a separate container, 125 parts of raw ungelatinized tapioca starch is dispersed in one hundred fifteen (115) parts of cold water. The resultant raw starch dispersion is then mixed with the above mentioned gelatinized starch hydrosol to form a final mixture consisting of raw ungelatinized tapioca starch suspended in a gelatinized starch hydrosol medium. The adhesive composition is then ready for use in the manner described above.

In this instance urea is used in the adhesive formula as it functions as a plasticizer to give a more flexible adhesive film. It also acts to lower the temperature at which the ungelatinized starch component will gelatinize during the heating step of the combining operation and thus facilitates rendering the ungelatinized starch to a glutinous condition during this phase of the process.

The use of a slightly dextrinized starch in this example to form the hydrosol carrier medium of the adhesive composition is not to any extent detrimental to the strength of the adhesive film inasmuch as the proportion of dextrinized starch to the total amount of unmodified starch is so small that the strength of the adhesive film is not noticeably adversely affected. The use of slightly dextrinized or otherwise modified starches in this manner is sometimes advantageous as a means of obtaining adhesive compositions of this type having more favorable viscosity characteristics than would be obtained by the use of a unmodified starch in preparing the hydrosol carrier medium of this type of adhesive composition.

Example III

Forty (40) parts of urea and fifteen (15) parts of corn starch are cooked with seventy-five (75) parts of water at substantially 190° F. so as to form a viscous hydrosol. In a separate container 125 parts of raw ungelatinized corn starch is dispersed in 125 parts of cold water. The re-

sultant corn starch dispersion is then mixed with the above mentioned gelatinized starch hydrosol to form a final mixture consisting of raw ungelatinized corn starch suspended in a gelatinized starch hydrosol medium. The adhesive composition is then ready for use in the manner described above.

Corn starch is not as suitable for the ungelatinized starch component of this type of adhesive as tapioca or potato starch due to its inherently higher temperature of gelatinization and its inferior agglutinant properties when gelatinized with small proportions of water. In the above example a sufficient amount of urea is used in the formula to lower the gelatinization temperature and improve the agglutinant properties of the raw corn starch component to a sufficient degree that the inherent unfavorable characteristics of the corn starch are largely overcome.

The above formulae are merely examples of the various modifications of the type of adhesive which we have found to be good practice for this process. We therefore do not wish to understood as limiting ourselves to these particular examples. We prefer to operate with more than 40% but less than 75% of water in our adhesive compositions for this process. In cases where a filling effect between the meshes of the cloth is desirable we have found that clay, yellow ochre, or similar inert materials may be added to the adhesive composition without detriment to the bonding strength providing the proportion of such material is kept below about 50% of the total dry material used.

The term "amylaceous" is used herein to cover dextrines as well as starches.

We claim:

1. A process for combining paper and comparatively open mesh fabric to form a laminated product having a bonding film between the individual cloth fibers and the paper surface of relatively great strength and having low shrinkage characteristics on drying, whereby the initial contact of the bonding film with the cloth fibers and paper surface is maintained, comprising applying to the surface of a paper a suspension of a relatively uniform layer of a non-adhesive ungelatinized starch in a viscous gelatinized starch carrier, bringing a loose fibered, open mesh cloth into contact with said paper surface and imbedding the individual fibers of the said cloth in said layer of ungelatinized starch, said ungelatinized starch being present in such major proportion in said suspension as to form immediately upon conversion a strong non-brittle tough adhesive film around said imbedded cloth fibers, said water being present in an amount of not greater than 75% of the bonding composition and sufficient to allow complete gelatinization of said ungelatinized starch upon the application of heat, and in an amount not less than 40% of the adhesive composition and sufficiently small to be taken up and held by said ungelatinized starch component upon conversion whereby the adhesive film substantially free from shrinkage on drying is formed and whereby contraction and expansion of said cloth and paper relatively to each other are substantially eliminated, converting said ungelatinized starch to a gelatinized form by applying a degree of heat in excess of the gelatinization temperature of said ungelatinized starch, and causing said resulting in situ gelatinized starch to set in contact with individual fibers of said cloth and the said paper into a continuous uniform and tough bonding film.

2. A process for making a laminated product of open mesh fabric and paper and having a bonding film between of relatively great strength and having low shrinkage characteristics on drying, whereby the initial contact of the bonding film with the cloth fibers and paper surface is maintained, comprising applying to the surface of a paper a suspension of a relatively uniform layer of a non-adhesive ungelatinized starch in a viscous gelatinized starch carrier containing urea, bringing a loose fibered cloth into contact with said paper surface and imbedding the individual fibers of the same in said layer of ungelatinized starch, said ungelatinized starch being present in such major proportion in said suspension as to form immediately upon conversion a strong non-brittle tough adhesive film around said imbedded cloth fibers, said water being present in an amount of not greater than 75% of the bonding composition and sufficient to allow complete gelatinization of said ungelatinized starch upon the application of heat, and in an amount not less than 40% of the adhesive composition and sufficiently small to be taken up and held by said ungelatinized starch component upon conversion whereby the adhesive film substantially free from shrinkage on drying is formed and whereby contraction and expansion of said cloth and paper relatively to each other are substantially eliminated. converting said ungelatinized starch to a gelatinized form in the presence of urea by applying a degree of heat in excess of the gelatinization temperature of said ungelatinized starch, and causing said resulting in situ gelatinized starch to set in contact with the individual fibers of said cloth and the said paper into a continuous uniform and tough bonding film.

3. A process as defined in claim 1 in which a film plasticising agent is added to the suspension containing the non-adhesive ungelatinized starch.

4. A process of laminating a fabric and paper materials, which consists in applying to the paper a layer of a starch composition in which a major proportion of the starch content is in an ungelatinized form carried in a state of permanent suspension by means of an hydrosol medium sufficiently viscous to prevent settling out of the ungelatinized starch yet sufficiently liquid to allow the mixture to be applied, heating the coated side of the paper before joining with the fabric sufficiently to gelatinize the ungelatinized starch whereby it becomes effective as a bonding agent, bringing the fabric into contact with the starch coated surface of said paper prior to setting of said bonding agent, and permitting said bonding agent to set about the individual fibers of the said fabric whereby a tough, evenly formed, bonded cloth and paper product is obtained.

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