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PROCESS FOR THE PRODUCTION OF COMBINATIONS OF RUBBER AND PAPER AND PRODUCTS OBTAINED THEREBY

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This invention relates to processes for the production of combinations of paper and rubber and particularly to such combinations where the rubber is in the form of a dispersion or emulsion; and to the products obtained thereby. The present invention is also concerned with an improved method for depositing rubber from a natural or artificial dispersion thereof upon paper making fibres of any sort.

The principal object of the invention is to provide an improved process for depositing rubber from a dispersion such as rubber latex, upon paper-making fibres. Another object of the invention is to make the fibres easier to handle in the beating and paper-making processes. Still another object is to increase the stability of the paper pulp and rubber dispersion with reference to each other in the beater, refining engines, stuff chests, and while running over the paper machine. A further object is to decrease the size of the rubber particles deposited from the dispersion upon the fibres. The invention also aims to furnish a means of obtaining better control of the rate of coagulation of the rubber dispersion. The invention also includes among its objects means for reducing the coagulation risk when sizing materials such as rosin size and loading materials such as clay, talc, colors, slate, etc., are added in the beater. Still another object is to precipitate or deposit the proteins from natural latex upon the fibres during the paper making operation.

With a preferred embodiment in mind but not desiring to place undue limitation upon the scope of the invention except what may be required by the prior art the invention briefly stated consists in mixing a protective colloid with a mass of beaten paper-making pulp, adding a rubber dispersion to the mixture after the latter has been made alkaline, depositing the rubber from the dispersion upon the fibres and coagulating the rubber thereupon, and forming paper from the treated fibres.

Heretofore it has been proposed to make rubber-containing paper by incorporating rubber latex with paper pulp. One proposed method is as follows:

Paper pulp is beaten in an ordinary paper-beating engine. After this operation is completed the contents of the beater are made alkaline with approximately one half of one percent ammonia, caustic soda, sodium silicate, or other alkali. The beater roll is raised off the bedplate, after which it serves simply as a means of agitating the pulp in the beater. The rubber latex or other emulsion containing rubber is then added in front of the beater roll to give the desired percentage of rubber on the paper pulp. After the latex has become thoroughly mixed with the pulp, the rubber is coagulated by the addition of zinc sulphate, (paper maker's alum) aluminum sulphate, or similar chemicals. This coagulation takes place in two stages. The coagulating solution is added to the material in the beater just in front of the beater roll so that it is immediately mixed with the pulp-latex mixture. This addition is continued until approximately two-thirds of the quantity of solution required to neutralize the alkali present in the beater has been added. After this point has been reached the addition of coagulating solution is stopped for a short time (say ten to twenty minutes). At the end of this period practically all of the rubber in the latex has been agglomerated and adheres to the paper fibre. After this stage has been reached the remainder of the coagulating solution is added, with enough excess to make the entire contents of the beater acid to indicators such as litmus paper.

The theory of adding the coagulant in two stages as above is that the first addition of coagulant causes rubber in the latex to agglomerate but not to coagulate. During the agglomerating stage the rubber is completely adsorbed on the surface of the fibre. After this adsorption has taken place, the remainder of the coagulating solution is added so that the agglomerated rubber is completely coagulated and set on the paper fibre.

It has been found that the addition of materials which may be classed as protective colloids greatly increases the ease of handling

latex in the beater and improves the resulting paper. A large number of these products are known, among which are the modified starches, of which the soluble starch esters appear to be the best. Examples of these starch esters are the acetylated starches known under the trade name of feculoid or feculose. In addition to these starches, it has been found that animal glue and casein are also very satisfactory materials. The effect of these products when used as above is to increase the general stability of the material contained in the beater. Also the coagulation of the latex in the beater takes place at a slower rate of speed when they are used, and the danger of too rapid coagulation is thereby completely eleminated.

It is a well known fact that when precipitates or coagula are formed in the presence of protective colloids, the size of the particles in the precipitates or coagula is always very much smaller than would be the case if the protective colloid were not present. In other words the particles can be made to approach more nearly a colloidal condition than where protective agents are not used. This effect may be obtained according to the present invention in connection with the coagulation of rubber latex on to paper fibre.

The preferred method of carrying out the invention is as follows: The paper making fibre is beaten until it has nearly reached the condition required to form a satisfactory sheet on any standard type of paper machine such as a Fourdrinier, cylinder, and wet machines. Before the beating is finished the protective colloid is added in amounts varying from 1 to 5%. Acetylated starches, glue or casein, or other protective colloid, may be employed, being added in solution or in a fine suspension depending upon the nature of the colloid. After the solution of protective colloid has been added, the mixture in the beater is then made alkaline with ammonium hydroxide, caustic soda, sodium silicate, or other alkali, until the mixture reacts decidedly alkaline to an indicator such as litmus. The beating is then continued until the fibre is in a suitable condition for paper making, by which time the protective colloid will have become thoroughly mixed with the fibre. The beater roll is then raised off the bedplate, so that it serves only as a means for agitation. A rubber dispersion, such as rubber latex containing either its normal quantity of rubber or diluted to 10 to 20% of dry rubber, is then added to the pulp in the beater, and preferably just in front of the beater roll. The rubber dispersion or the rubber latex is preferably strained through a fine screen or cloth at the time of addition. The beater roll continues to revolve and thoroughly mixes the latex or dispersion with the pulp and protective colloid. The protective colloid here serves to keep the rubber particles in a very fine state of sub-division. After the rubber dispersion has become thoroughly mixed with the pulp the rubber is agglomerated upon the fibres by the addition of some coagulating solution, preferably a solution of paper maker's alum. About two-thirds of the amount necessary to cause complete coagulation is added to the beater at this time, and the mixing is continued for a short period during which the rubber particles become deposited upon the fibres. Then the remainder of the coagulating solution is added, the amount being sufficient to impart a strong acid reaction to litmus paper.

In the preceding example the coagulation process has been carried out in two stages during the first of which the rubber is agglomerated on the fibres and during the second of which the agglomerated rubber is firmly anchored to the particles by the addition of a further amount of coagulant. The invention, however, may be performed by adding the coagulant slowly and continuously and in a sufficient dilution to prevent local coagulation during the early part of the process. When the coagulant is added slowly and continuously, agglomeration will take place first in precisely the same manner as when the rubber is deposited upon the fibre in two steps as described above.

When glue or other protein is used as the protective colloid it will be found that a much stronger paper can be obtained if the glue is set or coagulated by protein precipitants such as the heavy metal salts, organic color bases, the so-called alkaloidal reagents, the polyhydric phenols, for example tannic acid and the various so-called tannic extracts. Similarly a strong paper can be obtained if such protein precipitants are added to the paper pulp before the formation of the sheet upon the paper-making machine, when the pulp contains no additional protective colloid but only the protein derived from rubber latex. Undoubtedly in this latter case the increase of strength thus observed is due to the action of the precipitating agent upon the natural proteins which are present in the latex and at the same time upon the protective function of these proteins. After the coagulation operation has been completed a solution of a polyhydric phenol such as tannic acid or the like, may be added for the purpose of precipitating the protein, which is present when rubber latex is used as the rubber dispersion, upon the paper fibres. After the mixing operation has been completed the paper fibre is then handled in the standard way for making paper.

The amount of protective agent which is used for the above process depends to a large extent upon the particular pulp used and the results which are sought in the finished paper. Ordinarily the amount of feculoid, glue or casein which is required varies between one

and five percent. The same is true in connection with the use of tannic acid, although the best results have been obtained by the addition of approximately three percent of the weight of the paper fibres used.

It is standard practice in the manufacture of practically all paper to use commercial rosin size in order to give the necessary finish to the sheet. This material may be added to the beater at any desired stage in the process after the addition of the protective agent and alkali. It has been found in many cases that the addition of commercial rosin size to paper pulp containing latex prior to coagulation of the rubber causes some premature coagulation of the rubber in the latex on account of the presence of soda ash in the commercial size, with the formation of spots of rubber on the finished paper. This difficulty may be completely overcome by use of some one of the above protective agents.

It has been shown in this work that when approximately three percent of a soluble starch such as feculoid on the basis of the paper pulp contained in the beater is used, the strength of the finished paper is materially increased over that which can be obtained if rubber alone were used. The statement is true in connection with the use of tannic acid where glue and rubber or rubber alone are used. If the fibres of ordinary latex paper be examined by the microscope it will be seen that the rubber is deposited in minute globules or particles along the surface of the fibre. Under the same magnification, fibres from paper made according to the present invention reveal the rubber particles in a very much smaller size than in ordinary latex paper, and in many instances the fibres have the general appearance of being coated with a continuous film of rubber.

Having thus described our invention, what we claim and desire to protect by Letters Patent is:

1. A process for the manufacture of paper and rubber and similar combinations which comprises beating paper-making fibre, successively incorporating a protective colloid and a rubber dispersion with the fibre, depositing the rubber from said dispersion upon the fibre, and making the treated fibre into a sheet.

2. A process for the manufacture of paper and rubber and similar combinations which comprises beating paper-making fibre, adding a protective colloid before completion of the beating, incorporating a rubber dispersion in the presence of an alkaline material with the fibre, depositing the rubber from said dispersion upon the fibre, and making the treated fibre into a sheet.

3. A process for the manufacture of paper and rubber and similar combinations which comprises beating paper-making fibre, adding a protective colloid thereto, incorporating a rubber dispersion with the fibre, depositing the rubber from said dispersion upon the fibre, and making the treated fibre into a sheet.

4. A process for the manufacture of paper and rubber and similar combinations which comprises beating paper-making fibre, mixing a protective colloid therewith, rendering the mixture alkaline, incorporating rubber latex with the beaten fibre, depositing the rubber from said latex upon the colloid coated fibre, and making the treated fibre into a sheet.

5. A process for the manufacture of paper and rubber and similar combinations which comprises beating paper-making fibre, mixing a protective colloid therewith, rendering the mixture definitely alkaline, continuing the beating operation, distributing rubber latex throughout the mixture, agglomerating the rubber from said latex upon the fibres, continuing the mixing, coagulating the rubber upon the fibres, and making the treated fibres into a sheet.

6. A process for the manufacture of paper and rubber and similar combinations which comprises beating paper-making fibre, adding a soluble starch therto, incorporating a rubber dispersion with the fibre, depositing the rubber from said dispersion upon the fibre, and making the treated fibre into a sheet.

7. A process for the manufacture of paper and rubber and similar combinations which comprises beating paper-making fibre, mixing a soluble starch therewith, rendering the mixture alkaline, incorporating rubber latex with the beaten fibre, depositing the rubber from said dispersion upon the fibre, and making the treated fibre into a sheet.

8. A process for the manufacture of paper and rubber and similar combinations which comprises beating paper-making fibre, mixing a soluble starch therewith, rendering the mixture definitely alkaline, continuing the beating operation, distributing rubber latex throughout the mixture, agglomerating the rubber from said latex upon the fibres, continuing the mixing, coagulating the rubber upon the fibres, and making the treated fibres into a sheet.

9. A process for the manufacture of paper and rubber and similar combinations which comprises beating paper-making fibre, adding a starch ester thereto, incorporating a rubber dispersion with the fibre, depositing the rubber from said dispersion upon the fibre, and making the treated fibre into a sheet.

10. A process for the manufacture of paper and rubber and similar combinations which comprises beating paper-making fibre, mixing a starch ester therewith, rendering the mixture alkaline, incorporating rubber latex with the beaten fibre, depositing the rubber from said latex upon the fibre, and making the treated fibre into a sheet.

11. A process for the manufacture of paper and similar combinations which comprises beating paper-making fibre, mixing acetylated starch therewith, rendering the mixture definitely alkaline, continuing the beating operation, distributing rubber latex throughout the mixture, agglomerating the rubber from said latex upon the fibres, continuing the mixing, coagulating the rubber upon the fibres, and making the treated fibres into a sheet.

12. A process for the manufacture of paper and rubber and similar combinations which comprises beating paper-making fibre to which has been added from 1 to 5% of feculoid, said mixture being definitely alkaline, incorporating rubber latex with the beaten pulp and agitating the pulp, agglomerating the rubber from said latex upon the pulp by the addition of a portion of a coagulating mixture, continuing the mixing, adding a further quantity of coagulating mixture to render the beaten pulp distinctly acid, and making the treated pulp into a sheet.

13. A process for the manufacture of paper and rubber and similar combinations which comprises beating paper-making fibre, adding a proteinous protective colloid thereto, rendering the mixture alkaline, incorporating rubber latex with the mixture, distributing said rubber latex throughout the beaten fibre, precipitating said proteinous protective colloid along with said rubber upon the beaten fibre, and making the treated fibre into a sheet.

14. A process for the manufacture of paper and rubber and similar combinations which comprises adding a proteinous protective colloid to a mass of beaten paper-making fibre, rendering the beaten mass alkaline, mixing rubber latex therewith, depositing said protein and rubber upon the fibre by adding a protein precipitated to the beaten mixture, and making the treated fibre into a sheet.

15. As a new product, a paper containing rubber and a starch ester deposited upon its fibres.

16. As a new product, a paper containing rubber and acetylated starch deposited upon its fibres.

Signed at New York, New York, this 16th day of December, 1926.

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