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PAPER SIZING AND COMPOSITION
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The subject of this invention is paper sizing and compositions intended primarily for such purposes. It devolves more specifically about the surface sizing of paper which has preferably undergone sizing by the usual beater method.

It is well known that so-called tub-sizing of paper makes for a sharp increase in the Mullen or bursting strength of the paper, an increase in its fold endurance, but a drop in its important quality of tear resistance. The usual procedure is to pass the paper as it issues from the dry end of the paper-making machine through a bath of glue or gelatine solution, whereupon the treated paper is either dried in air, i. e., is left dried, or is passed over a bank of re-drying drums. The paper is commonly one which has been pre-sized by the beater method, according to which a rosin size or the like is added to the aqueous suspension of beaten fiber and then fixed on the fibers by the use of alum or other precipitating agent before being run out on the paper-making machine.

I have found that the injurious effect of surface-sizing on the tear resistance of the paper may be offset or in fact completely nullified if cellulose pulp in suitable condition, preferably in highly gelatinized condition is admixed or blended in suitable proportion with the glue-sizing solution. At the same time, the customary beneficial effects of surface-sizing can be realized and even enhanced. Thus, as is ordinarily the case, the Mullen strength of the paper is increased and this increase may be in excess of that secured by the use of a glue solution alone. So too, the folding endurance of a paper superficially sized with a blend of glue solution and gelatinized cellulose may be appreciably greater than that realized in papers superficially sized with glue solution alone. Evidently, the fibrillae or exceedingly short fibers which constitute the gelatinized pulp act as a reinforcement for the continuous glue film deposited and set on the paper,—resisting rupture as the paper is torn. So too, in so far as concerns the folding endurance of the paper, the gelatinized cellulose evidently reinforces and improves the flexibility of the glue film and thus inhibits the development of cracks in the paper when it is subjected to repeated foldings or flexings. Typical comparative results are given below in tabular form:

	Strength (Mullen)	Tear resistance	Fold endurance
Unglued (Case 1).....	90	200	800
Surface-glued (Case 2).....	110	175	1,200
Surface-glued with Gel (Case 3).....	115	195-205	1,400

These results are typical or illustrative although secured specifically in the case of a sheet of

paper which had been prepared by sizing the bulk pulp in the beater engine as usual with rosin size to produce a finished paper containing approximately 2½% rosin size based on fiber. The surface-sizing solution comprised approximately 6% glue and 2% hydrated cellulose, based on solution, with the hydrated cellulose dispersed uniformly throughout the liquid size. The papers prepared in both Cases 2 and 3 contained about 3% glue based on fiber, but the paper in Case 3 contained additionally about 1% hydrated cellulose on its surface along with the glue. It is to be especially noted that by the use of a blend of hydrated cellulose and glue as the surface-sizing medium, the tear resistance of the paper was appreciably increased, rather than sharply decreased as was the case when glue alone was used.

The specific example hereinbefore given may be somewhat departed from, but in any event only about 1% to 3% of gelatinized cellulose can advantageously be added to the glue solution. Below 1%, no noteworthy effects can be secured, whereas if one uses more than about 3%, the glue solution becomes so viscous as to be unsatisfactory as a surface-size. The gelatinized cellulose employed in securing the results cited in the illustrative example was prepared after the manner that cellulose fiber is conditioned for the fabrication of so-called glassine papers. In other words, the cellulose fiber was beaten hard for a long period of time until its fiber structure was essentially destroyed. This degree of hydration need not, however, in all instances be affected, although fine fibers must in all case be used so that the finished paper will have a satisfactory appearance, feel and writing properties. From the standpoint of securing intimate bond with the glue, it is of value to gelatinize the fiber. Consequently, while it is preferable that the fiber be highly hydrated or gelatinized, nevertheless, it is possible to attain the improvements hereinbefore noted to a greater or less degree, when the fiber employed for blending with the glue solution has merely undergone a reduction in fiber length as by beating or jordaning. Some types of fiber, like sulphite pulp, which are conducive to papers of good formation, texture, appearance and feel after undergoing comparatively little beating, need be beaten or jordaned to a comparatively slight extent, whereas comparatively coarse fibers like kraft or undigested cotton must undergo considerable reduction in fiber length before being admixed with the glue solution. The dry glue content of the glue solution may vary from about 4% to 10% based on solution and small quantities of agents like alum, formaldehyde and bichromate may be added thereto to preserve the glue against putrefaction as well as to promote setting or hardening of the glue to a water-insoluble con-

dition. When the dried paper is passed through the bath of sizing composition of the present invention, it takes on a superficial coating of the composition, and after redrying the surface-sized paper may contain from, say, 2% to 4%, glue based on fiber, together with about 1% more or less hydrated cellulose, depending upon the precise composition of the sizing bath. If the paper has not been pre-sized with rosin or the like by the usual beater method, the paper will of course absorb more sizing composition.

The kind of fiber selected as an agent for blending with the glue solution will in measure be determined by the qualities desired in the finished paper. For instance, when the body of the paper is made of high grade cotton rags or white refined wood pulps of high alpha cellulose content so as to possess good permanency or ageing qualities, the paper should be surface-sized with a mixture of glue and more or less hydrated pulp of similar permanency, as the use of an unstable fiber in the sizing composition would give rise to surface discoloration and deterioration upon ageing of the paper.

I claim:

1. A paper surface-sized with a composition consisting essentially of glue and mechanically gelatinized cellulose pulp distributed therethrough in such proportions as to increase the bursting strength of the paper without decreasing its tear resistance.

2. A paper whose body portion is sized with an agent like rosin and whose surface is sized with a composition consisting essentially of glue and mechanically gelatinized cellulose pulp distributed therethrough in such proportions as to increase the bursting strength of the paper without decreasing its tear resistance.

3. A paper surface-sized with a composition consisting essentially of about 2% to 4% glue, based on fiber, and about 1% mechanically gelatinized cellulose pulp, based on fiber, distributed through said glue.

4. A paper whose body portion is made up of stable cellulose fiber of high alpha cellulose content and which is surface-sized with a composition consisting essentially of glue and mechanically gelatinized, stable cellulose fiber of high alpha cellulose content distributed therethrough in such proportions as to increase the bursting strength of the paper without decreasing its tear resistance.

5. A paper surface-sized with a composition consisting essentially of glue in water-insolubilized condition and mechanically gelatinized cellulose pulp distributed therethrough in such proportions as to increase the bursting strength of the paper without decreasing its tear resistance.

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