

Prepared contributions

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THE author cites (page 718) Hill's work as evidence that the wet strength per unit retained resin is greater for the lower molecular weight fraction of an anionic urea-formaldehyde resin. This is based on Fig. 5 of Hill's paper and appears to be an incorrect interpretation of the facts. The error arises from comparison of wet strength performance of the resin fractions at the same addition level rather than at the same absolute retention level.

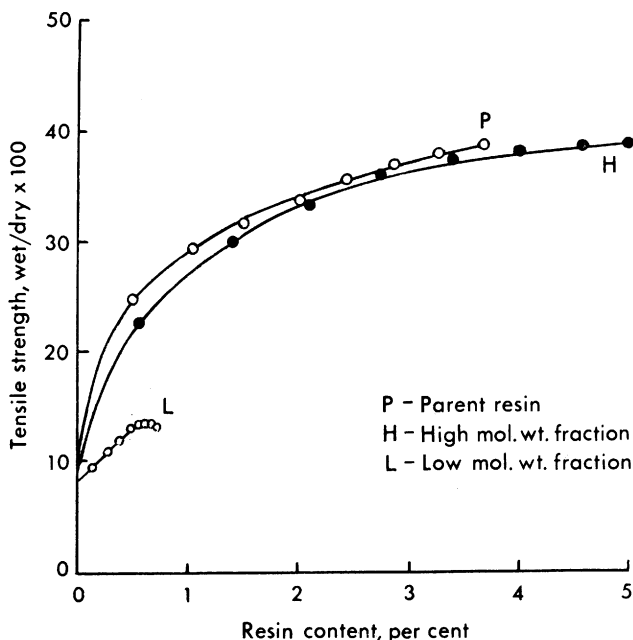


Fig. L

I have plotted in Fig. L Hill's Fig. 5 as percentage wet tensile strength (wet/dry) against the resin content of the sheet (per cent by weight). The points represent values calculated from Hill's curves at each integral percentage

addition. Clearly, the low molecular weight fraction is the least effective 'per unit of retained resin'.

Dr F. L. Hudson, College of Science and Technology, Manchester

THE suggestion from C. S. Maxwell that (cationic) melamine resin is of little value if it is deposited at anionic sites along 'free' fibre surfaces rather than at crossover points is interesting. If, as has been demonstrated,⁽¹⁾ resin can migrate over large distances under bad drying conditions, it could migrate from free surfaces to crossover points under normal drying and would be expected to do so if, under the Campbell theories of consolidation, the crossover points are the last places to dry. One difficulty about this suggestion is that the idea of crossover points (except possibly in 2-D sheets) seems essentially old-fashioned. Following the work of Page, Tydeman & Hunt,⁽²⁾ it seems that there is so little free fibre that in a moderately beaten paper the whole of the inside of the paper must be considered as 'crossover areas'.

Actually, it is well known that one can make perfectly good wet strengthened laboratory sheets by cold drying followed by oven curing under conditions in which resin migration must be very limited. The crucial factor is that the resin must get into the crossover areas while the fibre is still moist and conformable and, one would like to think, above its second order transition temperature under moist conditions.

References

1. Hudson, F. L., James, H. & Putman, J. L., *Tappi*, 1955, **38**(9), 166A-169A
2. Page, D. H., Tydeman, P. A. & Hunt, M., *Formation and Structure of Paper* Ed. F. Bolam (Technical Section, B.P. & B.M.A., London, 1962), 189

Transcription of Discussion

Discussion

Mr D. H. Page—Schwalbe has mentioned at a number of points in his paper the possible way in which starches and other materials improve the strength and he quotes (on page 708), 'Linke explains these gains by a "filling in between the fibrils and around the fibre-to-fibre contact points".'

About five years ago, we obtained direct evidence of the effect of starches on the contact areas. Tydeman and I took micrographs of contact areas in sheets before and after immersion in and drying from a starch solution. Typical results are given in Fig. M. These demonstrate quite clearly that a starch solution has two main actions. It fills in the contact areas and also creates bridges between fibres that were previously not in contact.

I think we can be a little more positive about the mechanism here of strength improvements attributable to additives than Schwalbe has been. This work was reported in the B.P. & B.I.R.A. *Bulletin* of June 1962.

Mr R. R. Davidson—The paper industry is the only industry I know that, when it wishes to decrease the pH value of an aqueous slurry, adds alum, not acid. This can well mean, as Schwalbe has pointed out, that in the final paper there may be an amount of alum in considerable excess of that necessary to develop the sizing.

In Fig. 1, as the rosin-alum complex concentration was increased, the strength of the paper fell and the opacity increased. The excess of alum appeared to be acting as a filler. A simple calculation shows that the alum is extremely expensive when employed as a filler in this way.

Dr H. C. Schwalbe—I have very little to say, because I agree with all these comments. I am very grateful for Taylor's study of the data by Hill. This new interpretation makes very good sense.

Hudson's contribution is most welcome. We need more discussion about the migration of these materials once they are caught. How do they move? We particularly wish to know how to get the bonding agents to the right place. At the moment, I am very much interested in synthetic fibres and the same problem exists of how to get the expensive bonding agent to the cross-over points and not to waste it somewhere else. So this is very interesting.



(a) Before immersion in starch



(b) After immersion in starch

Fig. M—Effect of starches on fibre contact areas

I am glad, too, for Page's observations. We wanted to demonstrate the location on fibres of starch or polyacrylamide, etc., but we did not know how to do this under the electron microscope. Our ambition was to show these small particles, because our general theme was (and still is) that we need to use these additives at the best state of dispersion so that only the minimum amount of starches, etc. are required.

I fully agree with Davidson and can add only one thing—that Watkins, for example (and I am sure many other experts in the rosin field), has advocated the use of sulphuric acid in addition to or in replacement of aluminium sulphate. Certainly, we know that excess alum (building up to a filler content of

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4.5 per cent) is a very expensive and not very efficient loading. It will be interesting to determine the specific alumina complexes that lower paper strength.

Dr W. Gallay—There is one comment I would like to make and it is similar to that made by Page, but adds a further practical element. All of us in industry, of course, are frequently approached by our friends from the chemical industry with bottles of rather magic materials that are intended to obviate all our problems. If not actually a cure for all our ills, they are often put in the light of a broad spectrum antibiotic that will cure many of them. There is one point, however, that is usually not mentioned. It is common experience that many extraneous adhesives give good results in sheets made from unbeaten or lightly beaten pulps, but their effect progressively decreases in magnitude until it is negligible with normal beating. The explanation has been given of course by Page.

To put the explanation differently, the lack of conformability at crossover points in the case of unbeaten fibres apparently leaves room for an added area of bonding by a bridging effect. With adequate beating, however, a maximum is reached through natural bonding, which is not further enhanced by the wet end adhesive.

Dr J. Grant—Schwalbe's curves show the variation in scattering power with the percentage of filler. The curves for titanium dioxide seems to start at 1 per cent and to fall with increasing concentration. What happens below 1 per cent?

Dr Schwalbe—It is intriguing to know if this scattering coefficient can go up yet more. We have data going below 0.5 per cent and have asked, of course, what its upper theoretical limit is. I reported in the paper that the very first data in this field by Shick gave an S_{pigment} value of about 22. Then it was pushed up to 44, now we have come up to 90–100 and we have debated what would happen, for example, if 0.25 per cent was used. We have insufficient data to answer reliably.

Dr A. B. Truman—Have you any evidence of the effect of the agglomeration of filler particles, with or without the use of polyelectrolyte retention aid on the distribution of the particles in the z -direction? My own experience is that there is a tendency for something of this kind to take place, resulting in preferential deposition of filler on the top side of the sheet. I have on occasion found (by sectioning the paper) that, in a sheet of about 25 per cent average filler content, the top side sometimes has as much as 78 per cent filler content.

Dr Schwalbe—I quite agree with these statements. We have similar figures and others given at the previous symposium by Groen. There is considerable evidence available in many mills.

Mr W. F. Reynolds—In Table 3, the electrophoretic mobility of several pulps is shown after treatment with aluminium sulphate. Measurements made in our laboratory on pulp fibres (actually fines) suspended in distilled water have not indicated the fourfold difference found by Vandenberg and Spurlin on aluminium sulphate treated fibres. In the vicinity of pH 4.5, it is very difficult to control the charge on alumina floc by adjusting the pH value, owing to the fact that the potentiometric titration curve for aluminium sulphate at pH 4.5 is quite flat.

I do not wish to imply that the electrophoretic mobility of treated fibres is of little value. On the contrary, our experience has indicated that properly used, this property of fibres can be useful for monitoring the use of additives in the papermaking process. The measurement can be done almost as quickly as a simple pH determination.