

Session 2: Prof. H. W. Giertz

THE mechanical properties of paper was a main topic both at the 1961 Oxford meeting and the 1965 Cambridge meeting and, as a better understanding of paper's strength properties will always be of great interest, it will certainly be included as a separate session in the programme of future symposia.

In the early fifties, Rance introduced his network theory and, somewhat later, Steenberg and his group the concept of microcreping. At the 1961 Oxford meeting, Nordman presented his fundamental work on paper breakdown, relating the energy absorption primarily to the breaking up of inter-fibre bonds under the formation of new surfaces as could be followed by the increase in light scattering. At the same meeting, Page & Tydeman introduced their concept of bonding before shrinkage, which gives the understanding of the microcompactions taking place within the fibres during the drying of the sheet. So at this meeting, Ebeling has taken an important step further. By the use of a very elaborate technique, he can measure the energy first developed and later absorbed by the paper during straining and breakdown. Thus, there has been rapid progress in obtaining the knowledge needed for the understanding of the breakdown of such a complicated material as paper. This rapid progress is to a very large extent due to the Cambridge and Oxford symposia with their critical discussions and inspiration for further research.

It is my opinion that we are now close to a fairly complete understanding of paper's mechanical properties and, for the work still needed to be done, I think that more emphasis should be placed on the behaviour of the *individual fibres*, both when strength is developed during drying and when the paper is broken down when loaded. More knowledge about the role of the individual fibres will, as I see it, be of great help when optimising those properties that are of importance for the end use of the paper.

The programme committee asked Dr Dodson to present a critical survey of paper mechanics in fundamental terms and we have received a very clear and stringent compilation. The same type of survey was delivered by Algar at the 1965 symposium and we should be thankful to get such surveys, especially when (as in this case) they are prepared by a scientist outside the paper business.

The theme of the present conference is to analyse and discuss fundamental

properties of paper related to its uses. In session 2, time allowed this to be done for only one type of paper—newsprint. The discussion was based on the paper presented by Lyne and co-workers and dealing with the in-plane tearing strength of paper. As I see it, two important conclusions can be drawn from this discussion.

Firstly, up to now, the Elmendorf tearing test has been considered as giving a good indication of the end use strength of the paper and this holds not only for newsprint, but for kraft papers and many other grades of paper. Optimisation of furnish, refining and papermachine conditions has therefore been based on the Elmendorf test. Perhaps the in-plane test will now prove to be a better one. Optimum tearing strength is reached at quite different sheet density, however, when based on the Elmendorf or the in-plane tester, thus the drive to improve tearing strength in two different papers depends first of all on which instrument has been used. This shows how important it is to have not only *a* testing method, but the *correct* method, when trying to improve the end product.

Secondly, the discussion on which properties are controlling the end use—in our case, pressroom runnability—showed that there was a pronounced disagreement between the participants. Most likely the situation would have been the same if strength requirements for other grades of paper had been discussed. The conclusion is clear: despite the fact that we *do* know quite a lot about paper's mechanical properties in general, we are still ignorant when it comes to the definition of relevant strength properties for specific paper qualities. There is a trend today within most laboratories—both in industry and research institutes—to give priority to research work on end use requirements. It is to be hoped that such work will be expanded and that the major part of the results, despite the obvious risk of restrictions through competition, will be presented at coming symposia.