DISCUSSION

MR. WILLIAM LANDES[1] (*presented in written form*).—The paper by Koontz and Owens presents data comparing strength characteristics of Kraft paper and synthetic fiber paper.

It is pointed out that synthetic fiber papers tear irregularly when tested by the Elmendorf tear method,[2] and for special uses the tongue tear method[3] may give more information through the stress-strain curves obtained with the latter method. Both the tongue tear method and the Elmendorf tear method were found to give valid measurements of tear strength for synthetic paper.

It is also pointed out that synthetic fiber papers have much greater stretch properties and take a longer time to break when tested for tensile strength. This would require a constant rate of loading or a strain rate of 200 to 300 per cent in order to break within a given time of 5 to 15 sec for a paper having a tensile strength of 11 lb per in. width. This may be excessive for normal use. A change in the method of testing synthetic fiber papers for tensile strength may be indicated. On the other hand the error introduced by testing synthetic fiber papers under the present method where a strain rate of 200 per cent is required to break the nylon fiber, resin A paper in 10 sec to give a tensile strength of 11.7 lb against the tensile strength of 11.4 lb obtained for a strain rate of 10 per cent and a time to rupture of 190 sec is 0.3 lb or approximately 3 per cent. This cannot be considered very significant.

The authors also point out that a 6 to 8 in. sample (jaw separation) should be used. Tappi Method T 404 m-50 specifies the distance between the jaws of the clamps as 7.1 in.

The data on the resistance of cellulosic fiber papers and synthetic fiber papers to various chemicals should be of great interest to users of papers for special purposes.

The data on dimensional stability is of timely significance. Many studies have been made indicating the need for paper having desirable dimensional stability characteristics. An example of this is the punch card used in business machines. Dacron papers, which the authors found to have 0.1 per cent change in length in the range of 26 to 97 per cent relative humidity, may be very suitable for this use.

The extremely high fold endurance of synthetic fiber papers is noteworthy. There are probably many special uses where this property is important.

The authors are doing a commendable job in providing information about this new product which should help it find many new uses.

MR. A. P. TRACY[4] (*presented in written form*).—This paper discusses generally the problems involved in testing papers

[1] Paper and Pulp Testing Laboratories, New York, N. Y.

[2] Method of Test for Pentosans in Paper (D 688 - 44), 1958 Book of ASTM Standards, Part 6.

[3] General Methods of Testing Woven Fabrics (D 39 - 49), 1958 Book of ASTM Standards, Part 10.

made from synthetic fibers and especially the ways in which the unique properties of these papers require special methods of testing.

Compared with cellulosic fibers, synthetic ones in a paper web have almost no natural fiber-fiber bond, and thus the untreated paper is almost completely lacking in wet or dry tensile strength, tear strength, etc. Synthetic resins are incorporated into the finished web, these materials substituting for the natural fiber-fiber bond. These synthetic binding agents have different properties than the natural ones and impart different properties to the finished sheet. Of course, the synthetic fibers differ in other ways from natural ones, that is, in tensile strength, elongation, chemical resistance, and dimensionally. These differences contribute to the properties of the resulting paper, but primarily it is the binding agent that imparts the unique properties to the finished web and which result in a need for special testing methods and interpretation.

MR. F. H. KOONTZ (*author*).—We at DuPont are aware of the importance of bonding agents in synthetic fiber papers. However, the inherent physical properties of synthetic fibers are largely responsible for the differences in the papers.

Actually, every time a new material becomes available, whether it be in the paper industry or elsewhere, we shall need to consider what are the characteristics of this new material. This is what we have attempted to do—to recognize that synthetic fibers are different from cellulose. How shall they be tested? How can we make use of these differences?

MR. CHARLES BARTELL.[5]—Two methods of tear testing have just been discussed. Both tests represent a continuation of a tear that has been started. In the fields of masking tapes, shoe innersoles, and paper coating bases for synthetic leather, I have found that the initial tear test is more representative of actual performance than a continuation tear test. Have the authors done any work along these lines?

MR. KOONTZ.—We are reviewing all kinds of tests. Right now, I cannot give a specific answer to the question. This point has been recognized, and work is going on.

MR. C. E. BRANDON.[6]—The authors state that when they made elongation tests at the same rate but on different length strips there was a two-or threefold difference in per cent elongation. Do they have an explanation for that? I cannot see why the per cent of elongation should change with the length of the strip.

MR. KOONTZ.—First of all, we should consider in any test method whether there is any slippage in the grips. Of course, the per cent elongation with very small slippage in the short sample is going to be magnified. That may not be the entire explanation, but it plays a very important role in the test results.

MR. J. K. OWENS (*author*).—One of the things that we would like to point out that probably is not clear in the paper, is that attempts to run the standard method for cellulosic papers on anything but the pendulum machine cannot be done. It cannot be done on an Instron, or any other machine like it, because the response is too slow. Here is something that is very interesting, because the value is always going to be

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lower than it should be. This is an important sidelight to the work that was presented here.

MR. T. W. LASHOF.[7]—With regard to the last question, there is now under consideration a revision of the tension test method which should take care of the problem under discussion.

I have another question: Is it the rate of separation per inch of material or just the total rate of separation that we are talking about here?

MR. OWENS.—The strain rate of separation.

MR. FRITZ M. K. WERDOUSCHEGG.[8]—I would like to ask the authors, on these various types of tear tests, whether or not they were considering that highly directional papers would have a curve test without having any resins in it at all, like pure Kraft paper would have a very curved test in a cross-direction and practically a straight tear in the machine direction when manufactured with a high directionality (MD over CD ratio of less than 0.70-1)

MR. OWENS.—If you take a highly directional kraft paper, in one direction you will get a straight tear so that it will agree with ASTM, because it is within the ±10 mm. In other directions the tear will be in an angle as in Fig. 2 (*b*), thus under the present ASTM methods, you have to throw it out because you cannot use it. On a highly directional kraft you cannot report your cross directional tear if it is an angle tear; that is, if you follow the specifications, and we have to abide by the ASTM specifications.

MR. WERDOUSCHEGG.—When do you start to define the directionality?

MR. OWENS.—Plus or minus 5 mm.

MR. WERDOUSCHEGG.—Then all the tests you had on the curve tests are no good?

MR. OWENS.—Yes. All the tests we had—if you assume that in the Elmendorf tests one must use the present ASTM limits—are no good: but the authors have said you do not need to eliminate them because they give you similar values.

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