DISCUSSION

MR. W. R. WILLETS.[1]—Could this Clupak method be adapted to multi-ply boxboard to improve the weak cross-directional fold?

MR. R. J. DIAZ (*author*).—We have not done a great deal on that as yet, but we are continuing to develop this paper, and that is one of the things which we shall be investigating.

MR. WILLETS.—What about the process applied to a cylinder machine?

MR. DIAZ.—At the present time, we have done no work on cylinder machines. I am speaking of Fourdrinier machines at the present time.

MR. WILLETS.—Would you suspect that a straight kraft liner would give the same effect as all the different stocks that you might have in a multi-ply boxboard?

MR. DIAZ.—That would be a matter of matching up both the stretch and the "toughness" of each ply because they would have to work together. Our product development department has laminated a 69-lb board to a 50-lb Clupak sheet which produces a virtually "crack-proof" 90-lb board. There is enough stretch available in the outer Clupak ply, after lamination, to resist cracking when the board is oven dry and bent 180 deg. This material is being produced commercially in substantial tonnages.

MR. J. K. OWENS.[2]—What is the modulus of elasticity of Clupak paper in comparison with regular paper?

MR. DIAZ.—Comparatively speaking, I would say we lose about 10 per cent of the modulus of elasticity of a regular sheet. The exact amount will depend on the total amount of stretch originally put into the Clupak paper. The higher the stretch, the lower the modulus of elasticity will become.

MR. OWENS.—How much stretch is being put into the Clupak paper?

MR. DIAZ.—About 10 per cent machine-direction stretch. We have found that 10 per cent seems to be about the optimum for runability on tubing machines. If we go higher than that, we get a sheet which is a little too flexible to run for normal bag-making operations, and we have much more "toughness" than we need. As a matter of fact, we are considering dropping down to 8 per cent stretch, which will be more than sufficient to give the extra "toughness" which we desire, and it will also improve converting operations on existing equipment.

MR. PETER R. LANTOS.[3]—Do you have any information on how the Frag energy test might correlate with bag performance, or did you run that test at all?

MR. DIAZ.—We have made the Frag test only enough to show that there probably is a correlation. We are also working with the Scott attachment for the Elmendorf tear tester which I believe is an impact resistance tester. It rup-

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tures a paper strip under impact conditions and gives a "toughness" value without either stretch or tensile strength. I have done some work with the General Electric puncture tester and have obtained some very excellent correlations between bag drop tests, Instron "toughness" tests, and General Electric puncture tests because basically we are measuring the same thing, namely, the ability of the paper to absorb work, or energy. Incidently, the Paper Institute has just concluded a report which covers various testing methods, including those I have just mentioned.

MR. CHARLES BARTELL.[4]—Do you lose any of the stretch introduced by sanforizing when you wet the paper?

MR. DIAZ.—We find that we do not lose any appreciable amount of stretch. As a matter of fact, if paper is wet only a little bit, you get more stretch because, as we all know, as relative humidity goes up, so does stretch.

One of our customers, a multiwall sack converter, conducted some tests along those lines. After fabricating identical sized regular and Clupak bags and filling them, they were set out in the weather for several months. They were subjected to rain and snow, turned over when dry, and exposed to the elements again. At the end of their test period several of the regular bags had disintegrated completely while all of the Clupak bags were still serviceable. It was not a scientifically controlled experiment, but it served their purpose for comparison.

MR. J. W. HOFFMAN.[5]—Have you any data on the effect of the process on dimensional stability?

MR. DIAZ.—Yes, as a matter of fact, we are doing some work on that right now. We hope to be able to establish the fact that this will be slightly more stable; but right now we do not have anything more conclusive on it.

MR. RALPH E. GREEN.[6]—Do you have any data on the Elmendorf "toughness" as compared to your tensile measurements?

MR. DIAZ.—I gather you mean our Instron "toughness" measurements. No, our research laboratory in Luke, Md. is doing that work and I have not seen the final report. However, the preliminary work indicates that there will be a good correlation.

MR. C. F. ACKERMAN.[7]—You stated that the surface properties of Clupak appear to be identical with regular sack kraft paper. Do you have any data supporting this on the problem of antifriction bags? That has been a big problem recently.

MR. DIAZ.—The work that we have done to date shows that we get as good, if not slightly better, anti-slip properties with Clupak.

MR. ACKERMAN.—Then, the surface is not the same?

MR. DIAZ.—No, not because of the surface but because the bag is a little bit limper. It is not quite so stiff. Rather than just sitting one on top of the other, they conform to each other, and give much better stacking. That ability to stack a little better is one of the things that the customers seem to like. The Clupak paper has more of a clothlike feel to it, which also seems to make it easier to handle. As far as the anti-slip properties are concerned, we can make a rough finish Clupak paper which is comparable to a regular kraft rough

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finish sheet. Using a Gurley test, we average around 15 to 20 sec, and as you know, 0 to 30 sec is considered a "rough finish." We have also used the slide angle test as an indication of relative smoothness, and obtain an angle of 26 to 28 deg on a rough finish Clupak paper, which is comparable to regular kraft. The big advantage of Clupak bags lies in the extra flexibility or conformity. In certain materials, cement for one, four standard size 94-lb bags made of Clupak will occupy the same space as three identical bags made of regular kraft. While this seems impossible, it is so because the Clupak bag will pack fully and not have stiff, unfilled corners and ends like a regular bag.