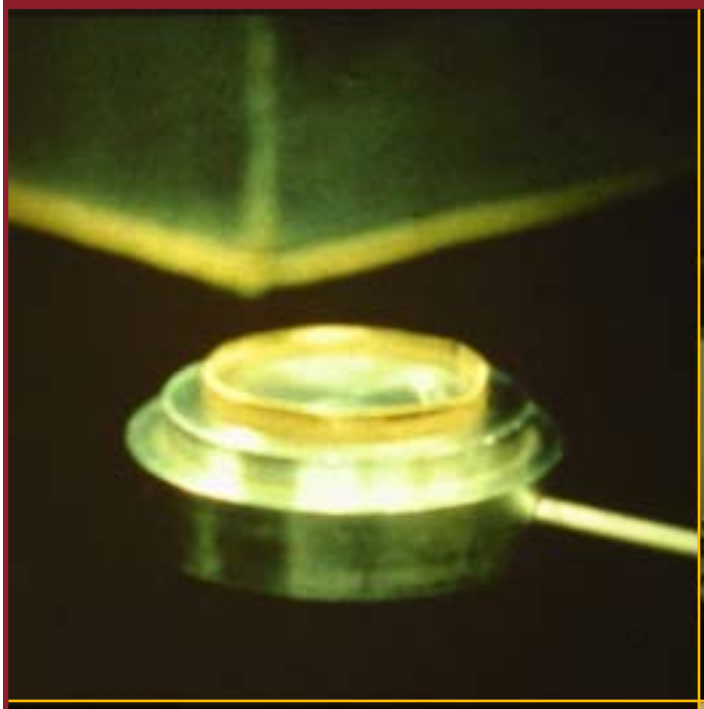
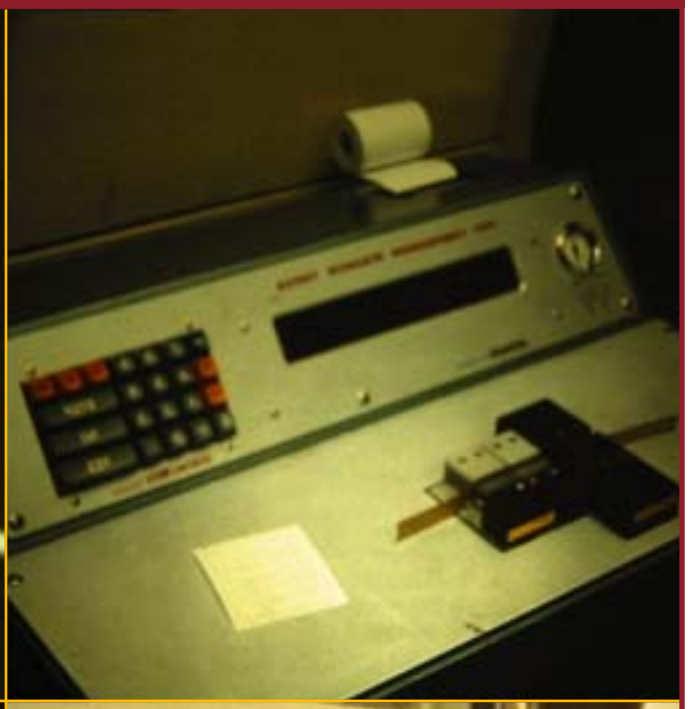
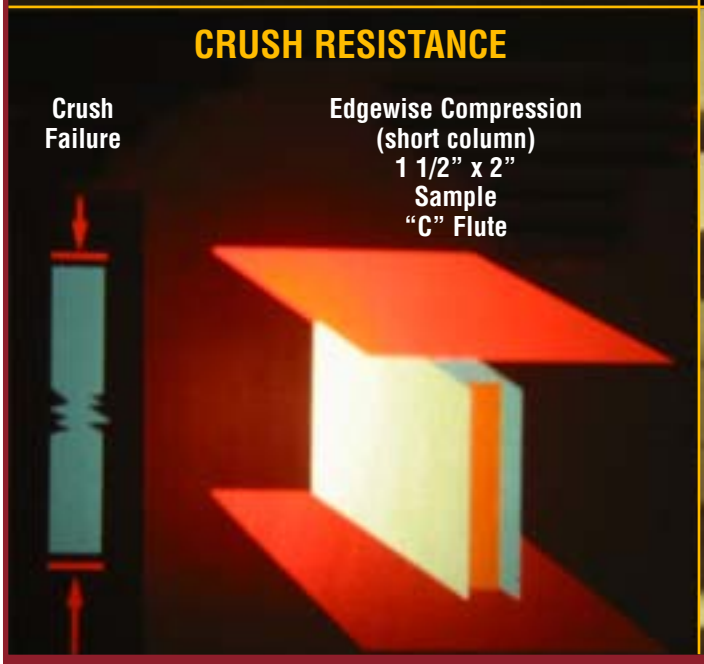
Summer 2007

CORRUGATING INTERNATIONAL

A TAPPI Publication for Corrugated Packaging Professionals www.tappi.org









Corrugated Packaging Division TAPPI people resources solutions

Focus on ECT

The Summer 2007 issue of Corrugating International returns to the more technical facets of our industry with a focus on ECT. A basic primer, a look at T 839 clamping pressure theory, and a spirited interchange of thoughts on various aspects of achieving acceptable ECT are included in this issue.

The subject of ECT degradation was mentioned in the Forum article but no data was presented on the extent of degradation or primary causes for degradation. Because of the many factors involved in achieving acceptable ECT, generalizations regarding ECT degradation as a part of achieving acceptable ECT are not easy to make. There is no one recipe for ECT success. The subject of ECT degradation is one that should be addressed by companies to understand the extent of any degradation, what the source(s) of that degradation might be (raw materials, corrugator or converting), and whether or not the degradation is keeping the plant from meeting the minimum requirements of the carrier regulations or the distribution system requirements of their customers.

Even the critical nature of clamping pressure for the most popular shop floor ECT test method, TAPPI T 839, is a factor as Dr. Ben Frank points out in his research article.

The industry has made and continues to make the point with it's customers that ECT grades are the cost effective way to design a package that meets the shipping needs for a wide variety of applications. We owe it to our customers to fulfill our industry's commitment to provide consistently good packaging and acceptable ECT is a part of that commitment.

This issue of Corrugating International has three reprints from other TAPPI publications, Paper 360° and Ahead of the "Curve. All are of interest to a wide variety of readers. I do want to encourage all to read the "The Workaholic". I recommend to those of you who haven't done so, to take a few days off. It would be great to find places where cell phones won't work, high speed internet connections don't reach, and the weather is nice. Take some down time and return energized to face the challenges of your job. As this issue of CI is being published, my family and I are enjoying our annual fishing vacation on the Minnesota/Ontario border.

David A. Carlson, Technical Editor,
Corrugating International, ci@tappi.org

Cover:
The cover shows a progression of photos that takes you through building a corrugated structure from Ring Crush and STFI (short span compression) to ECT and box stacking strength.

CORRUGATING INTERNATIONAL

A TAPPI Publication
for Corrugated Packaging Professionals

TAPPI people resources solutions®

Vice President, Operations
ERIC FLETTY

Publishing Director
LISA HIGHTOWER

Technical Editor
DAVID A. CARLSON

Art Director
JULIE STEPHAN

Corrugating International (ISSN-1525-4275) is published three times a year by TAPPI, 15 Technology Parkway S., Norcross, GA 30092, USA.

Statements of fact and opinion expressed are those of the authors and TAPPI assumes no responsibility for them; they are not intended nor should they be construed as a solicitation of or suggestion by TAPPI for any agreed-upon course of conduct or concerted action of any kind. Copyright ©2007 TAPPI. All rights reserved.

Send manuscripts for publication to the Editor at: Corrugating International, 15 Technology Parkway S., Norcross, GA 30092, USA. +1 770 446-1400, FAX/TWX +1 770 446-6947, www.tappi.org.

SUMMER 2007 CONTENTS

ARTICLES

3 Mullen vs ECT Testing Primer

7 Revisiting Clamped ECT

12 ECT Forum

17 The Impact of Nanotechnology on Sustainable Forest Productivity

20 The Workaholic

22 You can't play the game if you don't know the language

24 Industry News

Mullen vs ECT Testing Primer

George D'Urso

Editors Note: This "Mullen vs ECT Testing Primer" was presented at the fall 2005 TAPPI Conference in Las Vegas.

THIS ARTICLE, ALONG WITH THE FOLLOWING ARTICLE ON "REVISITING CLAMPED ECT" AND THE ECT Q & A FORUM FROM THE LAS VEGAS CONFERENCE THAT IS THIRD IN THE LINE-UP OF ARTICLES IN THIS ISSUE OF CORRUGATING INTERNATIONAL WILL PROVIDE THE READER WITH A GOOD BASIC UNDERSTANDING OF ECT, WHAT IS IT, HOW TO TEST, AND THE RELATIONSHIP TO MULLEN/BASIS WEIGHT BOARD COMBINATIONS.

For reference, Dr. Benjamin Frank published an article in the May/June 2006 issue of *Corrugated Today* titled "ECT as a Tool" that is a good companion to the three ECT-related articles in this issue of *Corrugated International*.

This article will provide a brief overview of Mullen and ECT. The following will be a discussion of the history of each test which will include how to measure, what they measure and what the applications with each have impacted the world today.

Starting with Mullen, Mullen by definition is the force required to puncture the surface of a sample line of a combined board. Mullen is used for liner, single wall and double wall boards. Triple wall is simply too rigid for its use. The Beach Puncture Test is used for triple wall and laminated structures and it's just a topic for another day.

Mullen originated in the textile industry. One of the applications was to help determine a fabric's ability to resist tearing from either an elbow or a knee. Where the fabric has been used for pants or for a shirt, there is a durability requirement that needed to be met for fitness for use.

Mullen began to be used in the paper industry early in the 1900's and, similar to textiles, it was related to durability associated with fitness for use. In the world of corrugated, corrugated was being used to replace wooden crates and technical claims were needed to support a transition. If you think about it, back in the early 1900's wooden crates were being used for virtually everything. As corrugated was replacing it, whether it be in produce or in any of the industries, the ability to withstand rupture from the inside out was a critical element and Mullen was an appropriate measure at that point in time.

To test Mullen, samples are clamped between two rigid platens (see **Figure 1**). Each platen has 1.24 inch hole in each plate, a rubber diaphragm is driven with hydraulic pressure and the diaphragm comes up through the bottom of the sample and it ruptures. The force required to produce the rupture is the Mullen result in pounds per square inch (PSI).

It should be noted that the clamp pressure has to exceed the pressure of the Mullen test result itself. What happens if your clamp pressure is not rigid enough is that your sample will literally push up the plates and then the sample will start to stretch and you will get an inflated value. You'll simply get a value that's higher than the actual.

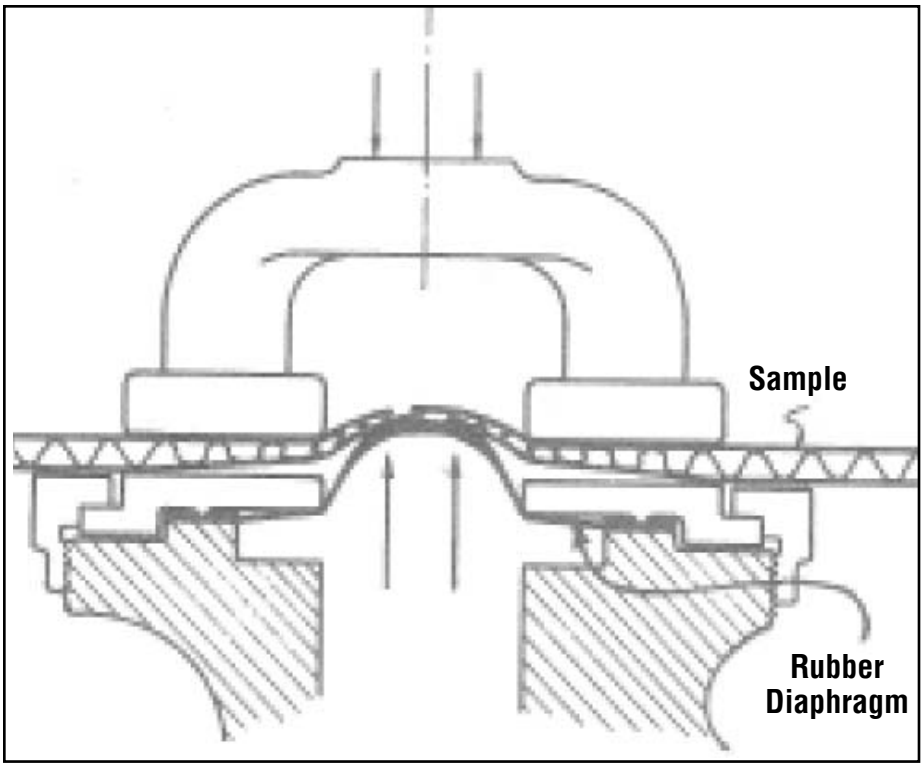


Figure 1:

Mullen itself is a combination measurement of tensile and tear. The work done by the Institute of Paper Chemistry (now the Institute of Paper Science & Technology) in the 1930's established a relationship and correlation between these two tests and Mullen. From a paper manufacture's standpoint, both measurements, tensile and tear, are key to production and to achieving a Mullen grade.

Medium has very, very little impact on converted board Mullen. Oftentimes that's hard to understand and hard to realize, but given the flexibility of its fluted form, medium offers very little resistance and has minimal impact on the Mullen value. For example, if you are looking at three board grades, all traditional 200 lb Mullen grades, 42 23 42, 42 33 42 and a 42 40 42, they virtually all have the same Mullen value. However to make a RSC from those three combinations, we all know that they are significantly different board combinations, and significantly different corrugated boxes, from a stacking strength standpoint, will be produced.

Mullen is considered a good measure of general integrity and durability and of a box. Generally it's not considered to be a quality measure of the corrugated process. Mullen is a paper specification, pure and simple. When you combine liners and medium into corrugated board you can actually reduce the Mullen during the corrugated process. You've got some pretty extremes pressure, in your pressure rolls. You can actually cut your liners. However it's very challenging to take a Mullen and reduce it during the corrugating process.

Crushing combined board caliper does not impact Mullen. As an experiment, combined board samples were cut from a common sheet of sample stock. The initial caliper was about 0.171. The Mullen was 254 lbs per square inch. The board was crushed 30 thousandths to 0.141 and the Mullen tested at 253 PSI. So basically the Mullen was unchanged regardless of the impact of the converting process. If you crush the board, you're still going to have the same Mullen.

It's helpful to know that if there's going to be an issue around transportation and validating a claim, you can test Mullen on a corrugated box that's been shipped, that's been abused, that's been knocked around and you'll get virtually the same Mullen as if it was a brand new board off of the corrugated.

From an application standpoint, in today's shipping world Mullen is an attribute that's applicable where tear resistance is important. Examples include small parcel environment, where individual boxes are exposed to drop, vibration, and manual handling. I know it's a gentle handling that boxes get in the UPS world, but where you're having that repeated handling on a single box basis, Mullen provides good integrity and will provide good protection from that type of handling.

Similarly, if your application is going to have some internal puncture - furniture, bulk petrochemicals, small munitions - this is another application for Mullen boxes. You know, there are packages where you have single bullets that are being shipped in bulk. They are loose filled and shipment of small munitions is a good application for Mullen where you can have an internal-to-out force.

If you are manually stacking filled boxes and there is a risk of those boxes toppling or falling from a reasonable height and the box might fall over and a corner of one box can impact another, in those situations a Mullen box will give you good integrity and will be able to handle that environment.

Lastly there are still some post office and military specifications that require Mullen. However some of

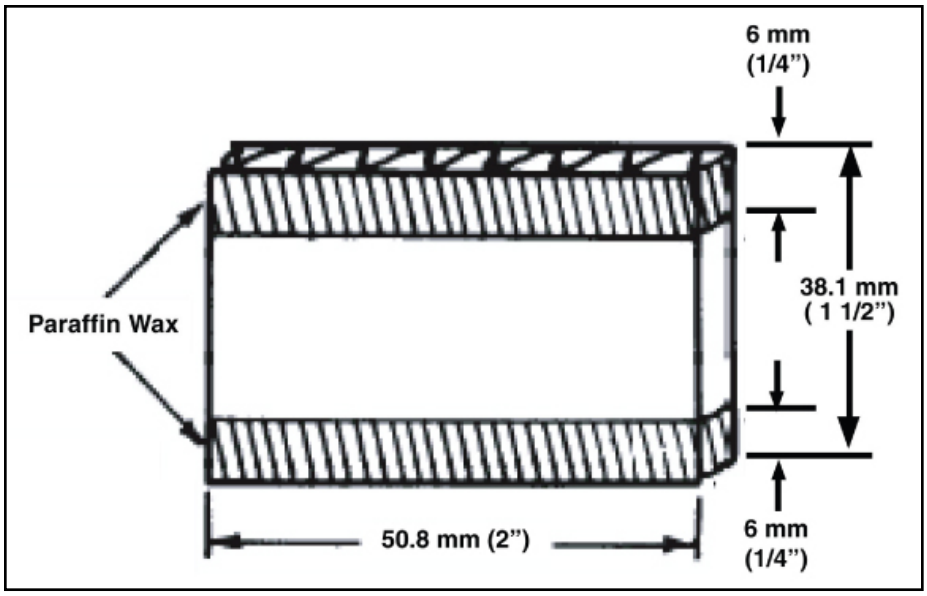


Figure 2:

those specifications are just throwbacks to specifications that haven't been upgraded and that may have been written prior to the time when Ring Crush grades were developed. These specifications just need to be upgraded.

Moving on to ECT, ECT by definition again is the maximum compressive force a corrugated sample can sustain until failure. Significant work was done in the 1950's to measure and understand the relationship between ECT and box compression. The most common known work is McKee, and McKee formula.

Briefly, samples are taken from a representative sample of the box. The size of the sample is dependant on the method of testing and in some cases the flute size. **Figure 2** in the schematic, shows a traditional T811 sample. It's two inches wide, flutes are in a vertical form and in this case it's a one and quarter inch sample so that would be for a B flute.

Compressive force is applied continuously in the top-to-bottom direction until the sample fails and the failure is observed in the middle of the sample. As with Mullen, there are some parameters and some variability built into the method, as well as into the operator. Sample preparation, no matter which of the four different methods out there you are using, all will give some variability within the method, generally speaking. However, it's all related to compressive force that's going to be applied to the sample. The other issue about sample preparation is, unlike Mullen where if you incorrectly test it, you'll get a high, artificially inflated value. Typically with ECT if you're going to get an artificially low value.

What is ECT? It's a characteristic of combined corrugated board that is directly related to the compressive strength of the corrugated package. ECT does include a medium factor as opposed to Mullen where medium has virtually no impact. Referring back to the same three board combinations mentioned earlier, 42 23 42, 42 33 42, 42 40 42; there is little difference in the Mullen, but with ECT you'll get roughly a 10% difference at each change. So if you went from a 23 lb medium to a 40 lb medium, you'd get about a 20% increase. Again, that would relate directly to your corrugated box and have a significant impact in the deliverable that you're providing to your customer.

ECT is a good predictor of box compression. The other significant difference between ECT and Mullen is that ECT is a quality measure of the target manufacturing process and component material, as opposed to Mullen, which is simply a corrugated specification. ECT is a combination of the CD Ring Crush of the liners and medium plus the corrugating process: how they're combined and how well they're converted.

It is true that when you get material coming into the box plant, quite literally all you can do is take away from the strength. Liner and medium has theoretical values that will have a delivered potential to give ECT and a box plant's task is to optimize the inputs and to utilize all the best box manufacturing techniques to make sure they can't decrease it. Basically, you've got so much Ring Crush and so much potential for strength and a box plant is only going to take away that strength.

In the crushing example discussion earlier, the same board grades the Mullens were tested on, the one sample that had a caliper of 0.171, has an ECT of 56 and we bring it down by 30 thousandths to a 0.141 now we're down to a 34 ECT. Roughly we've lost 40% of ECT simply by crushing it on our process.

One wonders about box plants that are looking to enhance their ECT opportunities by going to high crown profiles. They are changing a lot in the process but, in this example they left 40% of the strength on the table simply by mishandling it throughout their process.

From an application standpoint, ECT has got a wide variety of applications, but most everything is going to revert back to stacking strength. More important is the opportunity to provide an engineered product to our

customers. Once we understand the environmental conditions, the load bearing nature of the product, we can design a packaging system that will meet the needs in a most cost efficient manner. Again it's a matter of looking at what the process is, looking at the environment, looking at what the customers' needs are and then designing the package around that.

Other applications are where you have lightweight packaging that meets traditional shipping regulations. Lightweight products such as snack foods, paper goods, durable or self-supporting products, clothing, copy paper, they're all very good applications for ECT and they fit the need very well and again it'll provide a cost effective means to our customers.

In summary, there remain applications for both Mullen and ECT grades. The appropriate use of either of both is dependant on the customer' needs and can provide cost effective packaging for the customer as well as the manufacturing plant. Conversely, inappropriate use of either can deliver poor performance, failed packaging and lastly one that is very critical and very important, is the mistrust of a plant or an industry.

I've been to a number of packaging trade shows and conferences where people have said and have put up case studies and really mis represented ECT grades. Statements also have been made that the industry was using ECT as just a means to provide a poor product to their environment. The reality is, it was just mis communication and may have been mis design. If we don't introduce ECT grades appropriately and we don't utilize ECT grades appropriately and provide an engineered product, we may indeed have a product that's going to fail and then there would be mistrust in the plant or in our industry. **CI**

About the Author

George D'Urso has over 17 years experience in the corrugated industry. He currently holds the position of Operations Manager for Georgia-Pacific LLC's Innovations Institute in Norcross, GA. He is a member of several industry organizations and serves as Chairman of the FBA Technical Committee.

Revisiting Clamped ECT

Dr. Benjamin Frank

Abstract

Recent experiments indicate that for some samples the clamping approach for ECT measurement, TAPPI T839, can damage the specimens under test and leads to erroneously low results.

WE EXAMINE THE OPERATION OF CLAMPING TEST FIXTURES AND PRIOR LITERATURE, AND PROPOSE A MORE APPROPRIATE PRESSURE RANGE TO BE INCORPORATED IN THE NEXT TEST METHOD REVISION.

INTRODUCTION

The edgewise-compressive strength of combined board plays the most important role in overall box compressive performance. [1,2,3] Edgewise-compressive strength can be evaluated using a variety of different edgewise compressive tests (ECT) which all attempt to measure the fundamental strength of the combined board. The original approach to evaluating ECT is codified in TAPPI T811, and involves precision cutting and waxing of combined board specimens. Waxing the edges strengthens them in order to prevent premature failure due to edge rolling. Since during testing the loading platens push directly on the sample, the quality of the cuts can be critical.[4] Because of the challenges inherent in this approach, researchers in the 1980s sought other methods for evaluating combined board strength.

The primary alternate approach still in use today is the clamp method, codified in TAPPI T839. In this method, spring actuated clamps replace the wax in supporting the sample and preventing edge failure during testing. The original development of this method by Schrampfer and Whitsitt[5] found it "to accurately reproduce the "TAPPI ECT" (T811) results." They initially used clamping pressures of 5.3psi "for all board calipers", while subsequent work found that higher spring pressures improved agreement between the values measured with the clamps and with the traditional waxed approach. In the end they report choosing a fixture with two springs, each having a spring constant k=3.57kN/m (20.4lbs/in), to exert a clamping pressure of 49 and 80kPa (7.1 and 11.6 psi) on board with a thickness of 3.8 and 7.6mm (150 and 300mil) respectively. Their explorations appear to have been entirely on combined board off the corrugator, and were not focused on evaluating the strength of boxes.

Since the early 90's, measurement of ECT has shifted significantly from the waxed method to the clamp method. However, recent results demonstrate that the clamp and wax methods do not produce the same values when measuring the same samples,[6] and that test values for the two methods change in different ways depending on the damage level of the combined board in the box fabrication process.[7] Thus, it is not clear that the approach used to initially validate the clamping method is valid for all corrugated specimens.

In this technical note we reexamine the issue of clamping pressure in the development of the clamping approach. The current T839 standard (om-02) for testing ECT samples in a clamping fixture somewhat redundantly specifies both the spring con-

stant and the pressure to the sample. This can cause problems as manufacturers develop test fixtures to meet the method requirements. More critically, these specifications in the current method appear incompatible. Given that we now understand we cannot achieve the original goal of matching clamped and wax results for all samples, we revisit the test method specification to identify the range in clamping pressures under which one can expect to measure consistent results. Exploring the dependence of the ECT result on clamping pressure can provide guidance as to what pressures are actually required for testing, and how to revise the test method appropriately.

CLAMPING PRESSURES

Though the clamp method for evaluating ECT was originally developed using C-flute and CB-doublewall corrugated board, the clamping fixture has become the default method for many users no only for these board structures but also for B-flute and those structures outside of the definitions of the waxed method (e.g. E-flute). Most practitioners use the same clamping fixture for all board. However, as is clear in ***Table 1***, because of the way springs apply force, using a single fixture does not provide the same clamping pressure to different board types.

We can make some assumptions about the equipment configuration, and calculate the force applied to the sample specimens by the clamps using Hooke's law, F=kx. The pressure applied to the specimens is then P=F/A, where the area A of the clamp on the sample is approximately 1.6sq.in. k is the total spring constant in lbs/in, either of the single spring used or the sum of the constants for pairs of springs. We see that in theory the applied pressure increases with an increase in the thickness (x) of the sample under test, and have verified this relationship for fixtures in use today.[8]

We might assume that the pressure should be zero when the clamps are fully closed (faces touching) with no sample in between. In that case, **Table 1** shows that only when k is large (e.g. when using two springs of 52lbs/in, the value specified in the method) do we reach applied pressures on C-flute of 8-12 psi in line with the specification in the current method (T839 om-02). For that configuration, we can appropriately test most C-flute corrugated according to the current specification, but will be out of the requisite pressure range for most other structures. For clamping fixtures using only a single spring around 52lbs/in, we might expect appropriate pressures for doublewall board but not singlewall board.

One approach to adjusting the applied pressure is to have the spring under compression even when the two clamp faces are touching. This effectively adds a displacement to the calculation (x_0), so that the force is now $F=k(x+x_0)$. A few selected pairs of k and x0 appear in ***Table 2***, along with the corresponding pressures applied for different thickness samples. In order to meet the pressure specified in the test method for all board types, a fixture would need to

Sample	Typical Caliper (x, mil)	Pressure in psi varying spring constants			
		k=20lbf/in	k=40	k=52	k=104
31-23E-31	66mil	0.8psi	1.7	2.1	4.3
35-23B-35	113	1.4	2.8	3.7	7.3
56-33B-56	126	1.6	3.2	4.1	8.2
35-23C-35	158	2.0	4.0	5.1	10.3
56-33C-56	171	2.1	4.3	5.6	11.1
69-40C-69	180	2.3	4.5	5.9	11.7
31-23B-31-23C-31	263	3.3	6.6	8.5	17.1
69-26B-42-26C-69	285	3.6	7.1	9.3	18.5
90-40B-90-40C-90	315	3.9	7.9	10.2	20.5

Table 1: Calculated pressure applied to a range of samples of typical calipers for the various spring constants indicated. Values in bold satisfy the current pressure specification of 8-12 psi. Note that the current specification calls for a spring constant of 52±5lbf/in, but does not specify how many springs must be used.

have springs compressed substantially even when the clamps were closed (x_0=~0.6"), and a total spring constant (sum of all springs used) of k=~20lbf/in. No such clamping fixture currently exists in the North American market.

It thus does not appear that a fixture using springs with the spring constant specified in the test method can be used to satisfy the pressures required across the range of board structures typically tested. As well, there are no commercially available fixtures in common use in the US that can satisfy the test method's spring constant values and applied pressures for most common board structures. It is thus worth identifying what pressures are truly required, as well as what pressures are typically used in operation. We should be pursuing a system in which values measured using the clamping approach are consistent and resilient against perturbations or small variation in clamping pressure or sample caliper, and in which ideally we could use one fixture for the range of board tested.

ECT VS. CLAMPING PRESSURE

From comments in the original work on clamped ECT,[5] we might expect to find a range of ECT values as we apply different clamping pressure. However, given that clamped ECT values are sensitive to sample damage as a result of crush,[7] we need to be careful to avoid clamping pressures that are high enough do damage the specimens under test. Regmed, a Brazilian company that markets some equipment in the US through Thwing Albert, produces a dual-spring ECT test fixture in which one can adjust the stops that hold the springs against the clamps. Effectively, this allows one to vary the displacement x_0 and adjust the pressure on a specimen from 0psi to values above 20psi. Using this fixture we were able to explore the relationship between measured ECT values and clamping pressure.

For well formed C-flute board off the corrugator, where the combined board has not been crushed or damaged beyond the hardness of the medium,[9,10,11] we see that a wide range of clamping pressures result in essentially the same ECT value (***Figure 1***). When clamping pressures are very low we find that the ECT value drops off, consistent with earlier work and likely due to insufficient sample support. We see for the board with lighter medium that for higher pressures (>17psi) the value again

Sample	Offset x_0 (mil)-->	Current Method	Emerson Fixture	Initial work?	Requirement to meet range
		0	90	150	600
	Typical Caliper (x, mil)	Pressure in psi varying spring constants			
		k=52lbf/in	k=46.4	k=40.8	k=20
31-23E-31	66mil	2.1psi	4.5	5.5	8.3
35-23B-35	113	3.7	5.9	6.7	8.9
56-33B-56	126	4.1	6.3	7.0	9.1
35-23C-35	158	5.1	7.2	7.9	9.5
56-33C-56	171	5.6	7.6	8.2	9.6
69-40C-69	180	5.9	7.8	8.4	9.8
31-23B-31-23C-31	263	8.5	10.2	10.5	10.8
69-26B-42-26C-69	285	9.3	10.9	11.1	11.1
90-40B-90-40C-90	315	10.2	11.7	11.9	11.4

Table 2: Calculated pressure applied to a range of samples of typical calipers for a few selected combinations of spring constant k and offset x0. Values in bold satisfy the current pressure specification of 8-12 psi. The current test method column assumes a single spring. The Emerson Apparatus fixture data is based on parameters provided by Bill Holmes of Emerson Apparatus, while initial work column indicates the hypothesized conditions used by Schrampfer and Whitsitt based on the data in the literature. The final column indicates roughly what would be required of k and x0 to meet the 8-12psi pressure specification for all the combined board listed.

drops. At these pressures we apply forces that likely exceed the hardness of the medium, where the clamp itself is most probably causing damage to the specimens under test. For the stronger medium we do not see this drop off at the pressures we could access with the equipment. This is consistent with the observation that stronger medium is more resistant to crushing in the box fabrication process. From these and similar curves on B-flute and doublewall samples, we might assume that any pressure in the range of ~3-15psi should be acceptable and produce similar test values.

We find a somewhat different relationship when we perform ECT tests on production boxes (***Figure* 2**). The undamaged board off the corrugator again gives uniform results from 4-16psi, but box results are less consistent. For lightly crushed board, where the final caliper is within two mil of the initial caliper, variability goes up but we again have a consistent zone across most of that pressure range. For this box it is likely that we did not exceed the hardness of the medium during processing. However, once the board is more significantly damaged in converting the results get much noisier and we begin to see a drop off at higher pressures. For this box it appears that only pressures between 2-8 psi (maybe as high as 12psi) give close to consistent results. This implies that the "excess pressure" region where clamping pressure may damage samples and affect results moves to lower pressures as board is impacted by the box manufacturing process. This is consistent with drop off at particularly high pressures for the box with the lightest medium in **figure 1**, confirming that medium that has been damaged in processing is less resilient under subsequent impact.

Occasionally, boxes are damaged in the production process at levels significantly beyond what might be desirable, and it is important to be able to evaluate the ECT of those boxes using the same approach as board off the corrugator. ***Figure 3*** presents results on two sets of damaged boxes and the board from which they were made. These boxes were excessively crushed by any standard, with on the order of 20 mil caliper loss. Similar to the prior graph, we see a fall off in values at both the low and high end for samples that have been crushed in process. The "plateau"

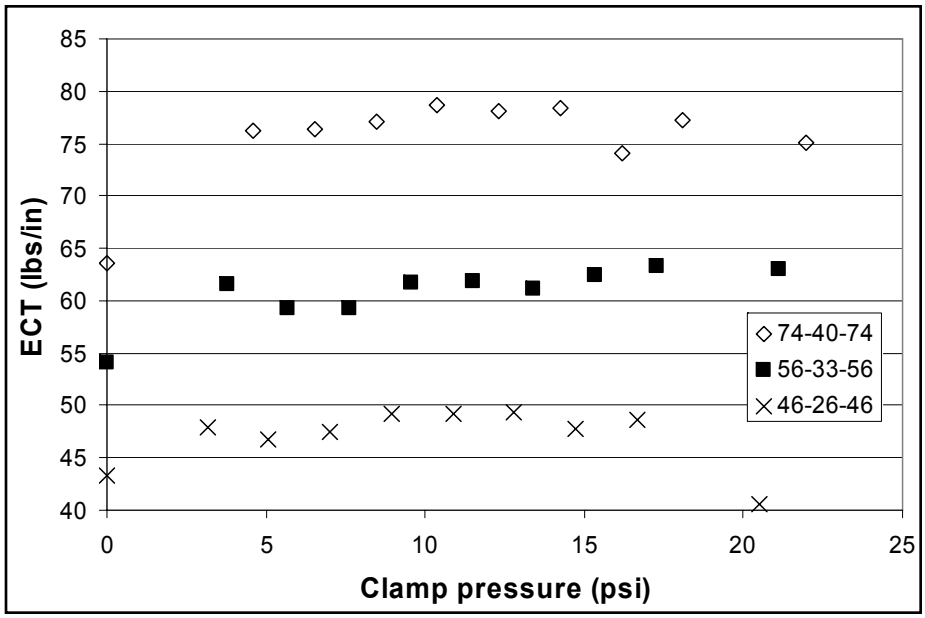


Figure 1: Clamped ECT values for different clamping pressures on three different C-flute board combinations off the corrugator. A typical confidence interval in ECT on an individual measurement is roughly ±1.3lbs/in, with uncertainty on clamping pressure no more than ±0.75psi.

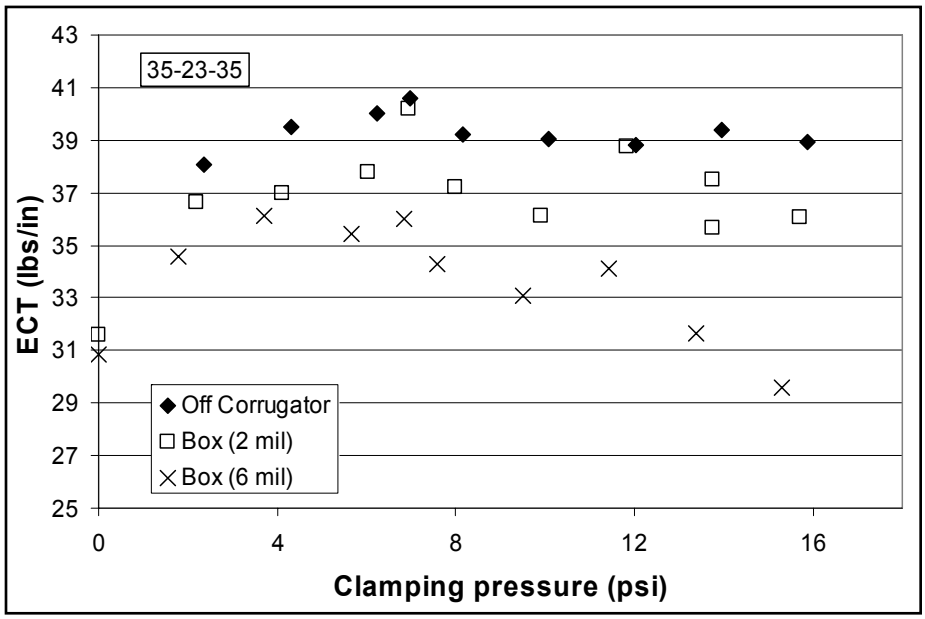


Figure 2: Variations in ECT with clamping pressure for one set of C-flute combined board off the corrugator and two sets of boxes made with that board, at two different levels of converting crush (final caliper loss). For reference, 2mil crush is good, and 6mil is probably not far from typical across the industry.

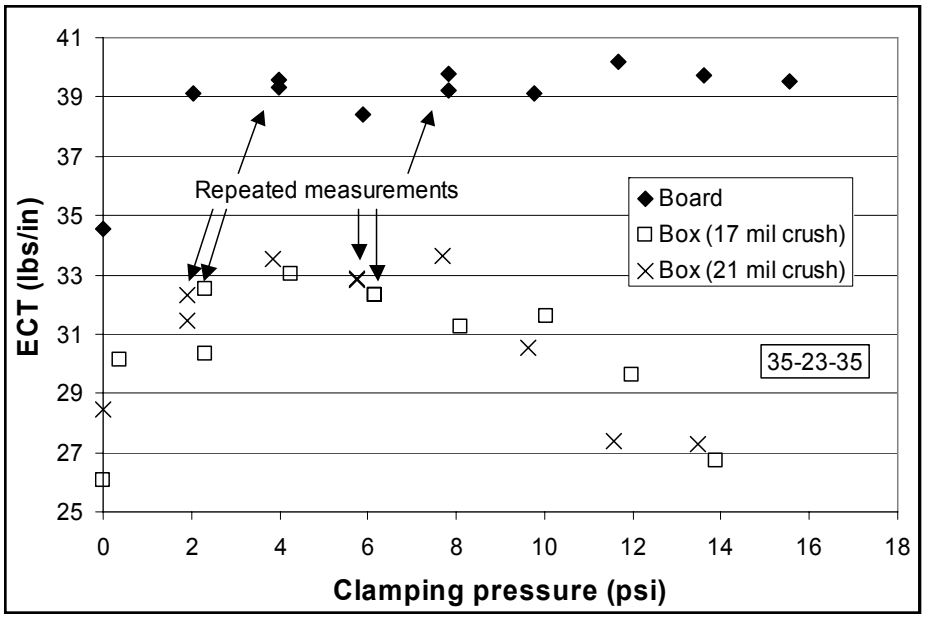


Figure 3: Variations in ECT with clamping pressure for another set of C-flute combined board off the corrugator, and two sets of boxes made with that board at much more significant levels of converting crush (final caliper loss). Repeated measurements are indicated, showing the relative reproducibility of this testing approach.

range is between roughly 2psi and 8 or 10psi, similar to the prior box sets with less crush. Even for these severely impacted boxes, repeated measurements show explicitly the (good) reproducibility of the measurement process, and support the global observation of ~1.3lb confidence interval on the values presented.

Given their constructions and the springs in use, many of the testing fixtures on the market today apply pressures around 6-8psi on C-flute board.[8] As we see in the second column of ***table* 2**, one of the most common fixtures in use in the U.S. applies pressures of roughly 5.5-8psi to nearly all B- and C-flute singlewall constructions.[12] For thicker board (e.g. CB doublewall), either off the corrugator or that is only lightly damaged from subsequent processing, these fixtures may produce valid and consistent results. However, once board is damaged significantly, the pressures exerted by these fixtures on thicker samples may exceed the point where the medium is further damaged and the measured ECT value drops off. It may thus be prudent to have a secondary fixture using weaker springs or a different offset for these thicker samples. This would avoid making measurements in the drop-off region.

CONCLUSIONS

This data implies an ideal target pressure of 4-8psi for the clamped ECT test, as pressures above or below this range may lead to artificially low or inconsistent values on some samples. While for some undamaged board off the corrugator, clamping pressures as high as 16psi appear to be acceptable, the current pressure range of 8-12psi appears to be too high for boxes that have experienced typical or significant converting impact. The lower range proposed is consistent with the initial work presented by Schrampfer and Whitsitt in the development of this test method, and reflects the desire to accurately assess board strength without further damaging board samples. Many fixtures in use today already operate in this range and would produce satisfactory results on nearly all singlewall structures. **CI**

1 McKee, R. C., Gander, J. W., and Wachuta, J. R., Paperboard Packaging 48(8):149(1963)
2 Batelka, J. J., Corrugating International 2(4):163(2000)
3 Urbanik, T.J. and Frank, B., Wood and Fiber Science 38(3):399(2006)
4 Eriksson, L., Boxboard Containers, March 1979
5 Schrampfer, K.E., and Whitsitt, W.J., Tappi J., October 1988. See also http://smartech.gatech.edu/handle/1853/3125
6 Frank, B., Corrugating International, August 2003, 3-6
7 Frank, B., TAPPI Corrugated Packaging Conference Proceedings, 2005. See also Frank, B., Corrugated Today, May/June 2006.
8 R. Popil, M. Schaepe, IPST, Personal communication
9 C.J. Crisp, R.A. Stott, and J.C. Tomlinson, TAPPI J, 51(5):80A(1968)
10 "Hardness of Corrugated Board", AS1901.445s, Australian Standard, Appita Testing Committee
11 Markstrom, H., Testing Methods and Instruments for Corrugated Boards, Lorentzen & Wettre, Sweden 1999, p.49
12 Data on the spring constant and offset for the Emerson fixture provided by Bill Holmes, Emerson Apparatus

Maximizing Profitability by Optimizing Package Performance: ECT & Light Weight Considerations

Editors Note: As a part of the "Maximizing Profitability by Optimizing Package Performance: ECT & Light Weight" session at the 2005 TAPPI & CPD Conference in Las Vegas a very spirited Forum was held that included questions and responses of various aspects of ECT.

THE TOPICS COVERED AND THE RESPONSES PROVIDED ARE AS RELEVANT TODAY AS THEY WERE TWO YEARS AGO. This article should provide all readers with information they can use in their day-to-day job activities.

Now we're going to turn to the forum discussion for your questions. We have CORBOTEC members in the audience with microphones. If you have opinions, that's fine but please put them in the form of a question.

Question: *What is the most common field failure mode or modes and how do these relate to ECT?*

GEORGE D'URSO: Actually I think that's a more involved question. Typically what I see as far as failure modes is going to be system failures. We've got very complex systems these days between standard RSC's and bliss boxes and display ready, shippers. The system failures that we're seeing are those related to a number of variables such as whether or not you have pallet overhang or where you have too much stretch wrap or whether you have an inappropriately designed package.

Related to ECT, it going to be the fact that we need to understand what the system needs are and then come back and design a package to handle the situation with the appropriate ECT for the need.

It's really related to understanding your system, understanding what the need is for the system and then designing through that.

BEN FRANK: Okay, I'd be willing to bet that you're going to get five different answers, so I'm going to give a part. I would agree with George and I'll probably agree with every else too. One of the ways we often use ECT, to answer your question, is that we can, because ECT plays a role in box compression strength. Typically one of the things we do wrong in our own shops is how we treat the board when we look at failures when they occur, and identify whether the problem is on our end.

Whether, despite the fact that we designed the box correctly for the system it might be in, we fabricated the box incorrectly or crushed it too much, or it had too low of an ECT, we can use ECT to understand the field failure. So that would be one aspect of answering that kind of question.

ROMAN POPIL: The question is, how do boxes fail, and the common field failure mode and what's the relationship to ECT? We did video observations of various boxes that we made at IPST and these included multi wall boxes. But for single wall boxes, one can generalize the field failure is that by and large the box was observed to bulge out if you have anything in it. Of course it would bulge out rather than inward with a filled box but it could go either way for an empty box.

So the panel will bow out as some-

thing reminiscent of a pillow and you have a concentration of the stresses, and we looked at this with the infrared thermography, at the corners, primarily. A crease will start to form in the corner at about a 45 degree angle with respect to the corner and that crease will propagate and that's what I think where the ECT stress is at its maximum. The ECT failure, in other words the compressive failure, starts at the corners and starts to propagate across to meet the other failure starting at the other corner and you'll have two arcs of a mean increase.

CHAD THOMPSON: I'm going to address this more from a box durability standpoint and the distribution environment, specifically the small parcel distribution environment, as I represent UPS. Where we typically see box failure with ECT board combinations is with either puncture or tearing of the corrugated package. We do a lot of investigative analysis by doing laboratory testing in accordance with a general simulation test like an ISTA 3-A test to try to replicate that field damage we identify.

Typically what we are seeing in the field and in the laboratory is that the box will either rip down a vertical edge, or one of the bottom edges, or we'll see punctures, almost like what George D'Urso talked about is his presentation, from the inside out of the corrugated. It is just a mis application. Our shippers are overloading the box.

Audience Comment: My take on field failure as a tech representative in the field is that there are two basic or two fundamental structural failure modes that I've seen. Either the box is going to fail because the manufacture's joint fails or the box is going to fail because the board fails. How do we define board failure? We can get into much bigger discussion there.

As it relates to joint failure, I don't think anybody would disagree that it doesn't relate to anything directly to ECT, but as a failure relates to board failure, I think whether it's design or quality or whatever the issue that causes that failure, I think we've seen from the presentation today that we can somewhat predict that failure by measuring ECT.

Audience Question: *In field testing that we've done, the results have been a little surprising, I need to know if it's typical or not. Testing 32 ECT board, B flute versus C flute, we're finding that B flute actually is about two lbs. higher than the C flute ECT tests and that was inherently surprising to me. What do you think?*

BEN FRANK: If you're combining papers that are the same, what we have seen is also an increase in B flute strength for the same papers over C flute strength and we have related that in my lab in part to the way the tests are designed and to the failure mode in the ECT test.

That doesn't mean the box will be stronger because the box also depends on the bending stiffness and the bending stiffness will go down for B flute much more than the ECT will go up. However, we have also gotten higher ECT values for identical papers combined using B flute and C flute.

Follow-up Question: *I have a follow up question. Thank you for the answer to that, I appreciate that. Second question is: the challenge in the box plant is that it takes too long to do ECT testing as often as we would need to, so we try to come up with the best correlating test to match ECT. Would you say that caliper is the best, easy test for a box plant to correlate with ECT values?*

BEN FRANK: The way you framed that question, one might be led to argue that caliper is the only easy test to do at the box plant and thus, it is the best test to do at the box plant. But if your box plant wants to test more physical properties on the combined board than simply caliper, the clamp ECT method is pretty quick and the easiest to do of the ECT methods. But caliper does correlate very well with ECT over a given range and how far that range works out is something that everybody's got to define for themselves.

Audience Response: The only thing I'd add to that is that caliper can be sometimes be misleading because there is memory. I agree that the combination of doing caliper and then doing the clamp ECT is good. As Ben mentioned earlier, clamp ECT is not the referee test. It won't give you an absolute value, but if you're looking for just process control and looking at process variability, the ECT clamp method really is a quick and easy way of testing it. Cut a 2X2 sample, put it into a clamp and you're ready to go. So it's really not that difficult to do and I think you need to combine the clamp ECT test with the board caliper test.

Audience Response: The interesting thing I head from what you said about the testing is that the clamp method reflects the damage that the board has seen when you crush it, so does the box. The waxed method does not show this to the same degree. Taking into account what you said earlier, redefining what the constants are in the McKee formula, might be the way to go. The most accurate way to predict how your box is going to perform is to use the clamp method and use not a modified McKee formula, but a McKee formula has new constants.

Audience Response: Without going into detail, I would argue strenuously that the wax method is, regardless of what parameters you want to redefine, the wax method will give you better predictions of box compression. I know there are people in the room who would disagree with me and that's a longer discussion so we'll leave it at that.

Audience Question: *Has anybody done any studies on an industry wide basis of the amount of degradation that's out there and what the ECT is and basically a correlation of those stamps and what's actually ending up in the market place?*

CHAD THOMPSON: I was approached this morning with exactly the same question by somebody sitting in the audience who's probably smiling very broadly right now. So there is a lot of industry wide interest and our industry tends to skirt away from industry wide projects at this point.

I know a lot of different people who've studied the question independently. Based on the material that goes through my lab that we get from sales folks and such, it does not appear that we always do the best job of meeting our guarantees, but I know we try as an industry very hard to do that.

Audience Response: The only addition is the fact that the problem with ECT is that it is an after the fact test. You don't know what the conditions of the samples were that came to you. So, to do an industry wide audit, if you will, from pulling samples from the field or just having people provide samples, it becomes a little bit more of a challenge. Like it or not, Mullen is real simple. You take it, you pop it, you get a number whether it's been crushed, rolled over, whatever. With ECT, you really need to be looking at almost a benchmarking that's been done in individual plants to be able to see what they're able to produce from the given ring crush of the roll stock they have. To pull samples form the field, you're already starting with a little asterisk next to it.

Follow-up Comment: Okay, let me ask you a real simple question. What percentage of corrugated box plants, from sheet plants all the way up to plants with corrugators in this country do you think have the ability to test for ECT? I'm not talking about guys who put stamps on boxes; I'm talking about plants that actually have the in-house ability to test specifically for it. I'll bet it will be less than 10%.

You've got a lot of smart people in room, who care about this stuff, but I can tell you, amongst sheet plants, I'm very active in the AICC, I can tell you right now, very few sheet plants have the ability to test their finished boxes.

GEORGE A. D'URSO: No argument on that because we're probably tilted a little bit to the integrated side so I can only answer for GP and for what we have in our plants. The sheet plant side is a whole other problem. Only the fact that, if you're purchasing sheets from a sheet feeder, where do you measure ECT? This also raises the point, if you're a sheet plant and you're producing 32 lb ECT, and you're purchasing sheets, should you be purchasing 40 lb ECT sheets because you know you're going to degrade it through your system so that when you deliver it it's 32? And that's a whole other issue that really is a quagmire that hasn't been really addressed.

Audience Question: *I want to go back to the question a few minutes ago about caliper. If you check ECT in a corrugated environment, in the southeast where I live, depending on the time of the year, the results are going to be all over the place. You don't have time to condition it, so you go with what you've got. At best, what you have is bogus information.*

Audience Response: There are corrections for moisture. Doing a moisture content on a board can take you a couple of minutes if you have a combination infra-red dryer with scale. If you have a gram scale and an oven, it may take a couple of hours to get an answer. Bogus is probably harsh. I still think its relative information. Again you're not going to be certifying. If you're using your shop floor ECT testing to certify a box, then that's incorrect.

Also to Ben's point, T- 811 is still the referee method, but if you're looking at it from a process control standpoint, and if you just want to see how you're doing today versus yesterday versus next week, and you correct for moisture, shop floor methods are okay. The same can be said for caliper. But, if you put a box at 90 90 and you take a caliper reading and then put it at 10% relative humidity and take a caliper reading, you're likely to have a different number. Because very moist board may not support the caliper anvil dead weight. So moisture is a challenge.

Audience Response: You're going to have a hugely different number for ECT if you're at those percent moistures and those percent humidities.

Audience Response: Caliper, you can check caliper going into your flexos. The humidity is the same in those few seconds from one part of the process to another so you're talking relative here.

But I suggest to the person that was asking about how you control this, develop a program. You can go to the lab, like taking samples daily or a couple of times a day of the paper and the combined board and have them tested. Control your process. And the simplest way to know that you're controlling the process on the shop floor is by caliper testing because if you do it right there before and after, you'll answer the question at the different steps of the process.

Audience Comment: And I don't argue that, I think that's a great plan. The only addition I would add to that, though, is that you've got to make sure if you're going to be relying that heavily on caliper, you're using caliper of your liner as it's going into your corrugator and caliper off the corrugator.

If you look at the caliper ranges in linerboard and if, you know if the

moon and Venus were aligned and you had the absolute low end caliper on all three components, medium and two liners verses and then the next time you hung the rolls, you had the absolute high, extreme on all three of those, you'd have a pretty significant caliper change.

Audience Comment: If you have a reliable mill supplier, the quality of your sheet coming in should be fairly consistent. You've got minimums that you know reasonably well and my understanding of what we'd be looking for on the corrugators are things we're doing to damage that sheet from the time it comes out of that hot plate section on down through the process.

You need to occasionally check and make sure you're not crushing at the bridge guides, but if you know your equipment, know what's normal, you look for what's not normal. If it's not normal, then you find out why it's not normal. But through your process, it's real simple to take the caliper before and after each process.

Audience Comment: I would just add that, following up on George's variation on caliper, just based on the papers we've gotten through our lab in terms of the industry range for ring crush for paper, what the industry might call 70 HP or 72 HP or 35 lb or whatever we want to call that grade, the ring crush average from suppliers that we've seen in our lab goes from 68 82 with one sigma deviation of somewhere between three and four.

So if you are fortunate enough to have a box plant that only gets supplied by one mill, you can probably do a pretty good job of guessing what your ECT is with a couple of baseline measurements and very close watching of caliper, because you know what your range is going to be within a much narrower window than if you happen to be a box plant that gets paper from lots of places.

So I can understand why somebody might want to do ECT in a box plant, just to find out where they're at and to benchmark their process. That's why it's critical that you know your equipment and your customer base so you can schedule the right paper for the right application.

Audience Comment: That's what I've been hearing this presentation, yes, that's a good addition.

Audience Question: *Could you have your panel reflect on the relationship, if any, between pin adhesion and box compression and or ECT? It's kind of a can of worms.*

Audience Response: Well you know these guys obviously know a lot more about the ECT and the technical testing part of it. My take from a field perspective is that if you have poor pin adhesion, poor bond, then you have more of a likelihood of the liner breaking away from the medium and failing, or be at the lowering of the ECT performance.

Audience Question: *Is there data to support that? As pins go up, does box compression follow? As pins come down, does box compression follow?*

Audience Response: No.

Panel Comment: I wrote a paper in 2000. It was in the *TAPPI JOURNAL* and related directly to that question. It was based on some previous work that was done in Europe and reports that were done in Europe and at the Institute of Paper Science and Technology. Actually there's a very small relationship between pin adhesion and box performance. However, I did notice that there are some relationships to basis weight that may have a higher impact. One thing I didn't look at is the atmospheric conditions. Once you start getting into different moisture conditions that can have an effect. Does any of the panel want to respond further to that?

Audience Comment: We have some fairly good data from a fairly controlled experiment on pin adhesion versus ECT and it confirms some thoughts we've had for a long time. There is some industry disagreement on this, but it appeared to us that a 40 pin adhesion was a break-point. Above that it didn't seem to matter a whole lot. And that's a pretty low number, but that's our facts, and they are pretty good facts.

Audience Question: *I'd like the panel's opinion of using balanced versus unbalanced liners when they're taking and checking for ECT values, are there any combinations that are better than others in that particular light? I know that there are a lot of variations that are used out in the field.*

Panel Response: ECT is a symmetric test and mismatched liners are a non symmetric situation. The correlation between ECT and box compression gets weaker at some level when you're running mismatched liners. For instance it's, generally agreed upon in the industry that if you were to run a combination of 42, 26, 69, with the 69 on the inside, the box compression would be stronger than when the 69 is on the outside because of the contribution of the heavier liner associated with the direction that the box actually fails. It will tend to bow out because of the contents on the inside. But, the ECT is going to be the same, so there is some fogginess in exactly what the relationship is when you start unbalancing your liners.

Panel Response: In the references there is a German reference, Volmer is the name that comes to mind, and he covered that issue. The takeaway item there is that paper is weaker in compression versus tension by about a factor of two. Essentially if you're making a box, you want the heavier liner to be on the inside and the lighter liner ought to be on the outside, due to that fact.

So because on the inside if the panels are bowing outward, if you have a box filled with something, as is more often the case in terms of failure mode then the inside liner is just that much more resistant to failure. If the situation would be reversed and way, that is if you go to lightweights on the inside, there's more buckling that comes into play which can basically confuse that relationship. But intuitively that's where you want it to go, with the heavier liner on the inside and the lighter liner on the outside of the box.

MICHAEL SCHAEPE: When compression strength exceeds critical buckling load, inter flute buckling occurs and ECT is adversely affected. The result of inter flute buckling is lower ECT than that predicted from the sum of the component compression strength. Secondly with today's lightweight liner boards with high density, low caliper and low bending stiffness, these have resulted in a greater occurrence of inter flute buckling.

That's all the time we have for this panel. There were three great presentations and we had a good response from our panel. I'd like you to give them all a hand. CI

The Impact of Nanotechnology on Sustainable Forest Productivity

by Maud Hinchee

Editor's Note: This paper was originally presented at the 2006 International Conference on Nanotechnology. This year's Conference, held in Knoxville on June 13 -15 was a great success.

Plans are under way for another Nanotechnology Conference in the summer of 2008.

ABSTRACT: THE UNITED STATES FOREST INDUSTRY CAN IMPROVE ITS GLOBAL COMPETITIVENESS AND FUTURE VIABILITY THROUGH ADVANCEMENTS IN SUSTAINABLE FOREST PRODUCTIVITY. A major reason for this is that wood is the largest cost in producing pulp, paper and building products. It is only through advances in forest technology that reductions in wood production costs can be achieved while also achieving greater wood yields.

In this paper, we will discuss the four current research focus areas for the Agenda 2020 Sustainable Forest Productivity Roadmap, in terms of the needs faced by the industry and the research objectives. WE will also discuss the application of nanotechnology to achieve our objectives.

It is important that the forest industry invest and capitalize on the advantages that nanotechnology applications can provide towards improved sustainability, improved productivity and the creation of higher value products.

NANOTECHNOLOGY: A GENERAL DEFINITION WITH AN EXAMLE FOR THE PULP AND PAPER INDUSTRY

A nanometer (nm) is one-billionth of a meter. To put this size in perspective, a sheet of writing paper is about 100,000 nanometers thick; 10 hydrogen atoms laid in a row are one nanometer wide. We're surrounded by hard-working nanosystems every day-many provided by Mother Nature, the original (and still most efficient) nanotechnician. The term nanotechnology is often used to cover any research, process or production at the nanoscale; the true aim of nanotechnology, however, is not to merely see or catalog phenomena at this scale, but to control and manipulate materials to obtain a special function. In other words, size matters-but it's not the whole story. Sandwiched between the visible and the molecular, this mesoscale is governed by its own rules, a difficult-to-predict hybrid of Newtonian law and quantum physics. Materials at this scale have entirely different properties than smaller- or larger-scale materials; they respond and interact in unique ways. Harnessing those differences to create valuable, predictable and controllable outcomes is the key goal of nanotechnology research. As a science, nanotechnology is the place where engineering, biology and chemistry meet. A primary nanotechnology research area within the pulp and paper industry is to harness the properties of lignocellulose, another of nature's remarkably efficient self-replicating mesoscale machines.

RESEARCH GOALS FOR SUSTAINABLE FOREST PRODUCTIVITY

The goal of Agenda 2020's Sustainable Forest Productivity initiative is to develop and deploy wood production systems for our nation's forests that are ecologically sustainable, socially acceptable and economically

viable, thereby enhancing our understanding of our forest ecosystems and the global competitiveness of forest-based manufacturing and biorefinery systems in the United States.

The Initiative has four research focus areas:

1. biotechnology and tree improvement
2. wood quality
3. forest management, and
4. ecological functions and ecological services of managed forests.

The roadmap to advance the competitiveness of the US forest industry through advancements in these research areas is outlined below. Some of these advancements will be based on improvements in existing capabilities while others will depend on the application of evolving technologies such as genomics, biotechnology and nanotechnology.

FOCUS AREAS OF THE SUSTAINABLE FOREST PRODUCTIVITY ROADMAP

1. Biotechnology and Tree Improvement

Needs faced by the industry:
The generation and implementation of improved hardwood and softwood planting stock is limited by the lack of a national strategy for advancing and applying a scientific understanding of forest genetic resources. Utilizing the natural genetic diversity of our plantation species will require enhanced knowledge of the genetics and genome of key plantation species.

In addition, increased ability to produce the volumes of improved planting stock required to meet the industry's needs is essential. We lack high efficiency softwood tree propagation systems that allow for the planting of improved genotypes. This is essential as softwood species make up the majority of the nations reforestation seedlings and building products. We also need to develop hardwood production systems that are capable of competing with the productivity of Eucalyptus plantations in the Southern hemisphere.

Objectives:

1. Accelerate testing and deployment of clonal forestry systems for softwoods.
2. Sequence the active genome of *Pinus taeda* (loblolly pine).
3. Develop methods for conifer transformation that work for all superior genotypes with high efficiency.
4. Accelerate testing and deployment of hybrid larch as a plantation species in the United States.
5. Define and minimize risks that may be associated with transgenic trees.
6. Develop a cold hardy Eucalyptus for use in plantations in the United States.

2. Wood Quality

Needs faced by the industry:
We lack reliable quantitative estimates of the value of wood quality improvements to manufacturing in terms of energy efficiency and product quality. This information is necessary in order to achieve the competitive edge provided by superior quality or by increased product production at lower costs.

Objectives:

1. Develop rapid, cost-effective methods for measuring wood properties that affect end uses.
2. Develop explicit and detailed models of the value of wood quality improvements to manufacturing in terms of energy efficiency and product quality.
3. Determine how key measures of wood quality are affected by site factors, stand conditions, management practices and genetics.
4. Develop new silvicultural options for controlling wood quality in intensively managed plantations.
5. Improve understanding of biological processes for controlling transition from juvenile to mature wood.

3. Forest Management

Needs faced by the industry:
We lack a national strategy for integrating technology, policy and economics to spur the development of "precision forestry" and "landscape management" as components of sustainable wood production systems.

Objectives:

1. Update growth and yield models to account for changes in stand conditions, management, practices and environmental variables.
2. Develop new fertilizer formulations, application practices, and diagnostic techniques to enhance the economic and environmental performance of forest fertilization programs.
3. Develop new generation analytical models to evaluate changing economic conditions affecting wood fiber supply and demand.
4. Ecological Functions and Ecological Services of Managed Forests

Needs faced by the industry:
We lack a national strategy for gathering and analyzing information on the current and potential contributions of managed forests to sustaining water quality and biodiversity. We also lack reliable quantitative estimates of the potential of different forest management systems to sequester carbon and reduce greenhouse gas emissions.

Objectives:

1. Develop and test methods for measuring and recognition the contributions of managed forests to sustaining water quality and biodiversity.
2. Quantify the potential of forest management systems to sequester carbon and reduce greenhouse gas emissions.

3. Define costs and benefits of alternative methods for managing logging residues and mill residuals and biosolids.

APPLYING NANOTECHNOLOGY TO ACHIEVE OUR OBJECTIVES

Nanotechnology will enable many of the technological advancements we need to achieve. The application of nanotechnology to decipher how the tree genome manifests different phenotypes associated with growth, wood quality, and adaptability, especially in response to different environmental situations, will exponentially increase our ability to improve tree planting stock. This will result in the ability to produce faster growing and hardier trees than retain industrially useful properties to maximize productivity of plantation forest land. Improvements in the ease of manufacturing or in the functionality of wood could be achieved through the application of biomemetics and self-assembly. Application of this developing research area would enhance fundamental understanding of molecular recognition in plant growth and cell-wall self-assembly in forest products processes to create new or enhanced existing products. Knowledge of how molecules in woody biomass self-assemble can lead to new uses of the cell wall constituents as a chemical feedstock.

Cell wall nanotechnology will develop new methods will provide new ways to investigate cell wall structure by non-invasive microscopic and spectroscopic measurements and to gain knowledge of cell wall structure and mechanical properties. Improved product diversity and properties, through the modification of wood feedstock to meet product-specific requirements such as the generation of thinner walls in southern pine, altered ratios of cell wall components, more flexible fiber, and fiber of improved absorptive properties, will create higher value or new products. It will also allow for the enhanced use of non-merchantable timber, wood processing residues as sources of biomass to compensate for declining fossil fuels.

Nanotechnology, through interactions in the disciplines of genomics and biotechnology, will be utilized to determine the manner in which the tree's genetic information influences the assembly and consolidation of the cell wall and affect the cell walls' biophysical and mechanical properties. Nanotechnology will aid in the understanding of how cellulose, itself a nano-biomaterial, is controlled by genetic, biochemical, cellular and biophysical processes.

Nanotechnology-based sensors will be applied to improving wood and lignocellulosic properties, but also as an aid in precision forestry and landscape management. Nanosensors incorporated into wood based material could provide an early warning of disease and pest damage in the forest and act as an early warning of mold or termite damage in lumber. It is even possible to conceive that nanoscale processes will then be able facilitate self-healing in wood and trees in response to environmental or biological damage.

Nanosensors will also be utilized in the future to monitor forest health and enable us to better maintain healthy forests, landscapes and ecosystems.

CONCLUSION

It is important that research to develop technologies to achieve our current and future sustainable forestry objectives capitalize upon existing and evolving nanotechnologies.

Nanotechnology will enable us to increase our knowledge base of forests and forest trees, and will assist us in rapidly implementing forest genetic improvement through breeding, genomics and biotechnology. New or improved wood-derived products will be made possible through the biological, biochemical and biophysical insights made possible using techniques derived from nanotechnology.

The application of nanotechnology will enable new methods to measure the biotic and abiotic factors that affect plantation performance. It will also assist us in measuring the dynamics that affect forest ecosystems and provide opportunities to mitigate negative factors that would decrease productivity.

Nanosensors and nanomaterials will increase our ability to practice precision forestry and landscape management in order to achieve the environmental, social and economic objectives of the forest industry. It is important that the forest industry invest in understanding how to apply nanotechnology towards improved sustainability, improved productivity and the creation of higher value products from our nation's forests. CI

Acknowledgement: This paper is based on the Agenda 2020 Roadmap for Sustainable Forest Productivity and the Summary of Nanotechnology R&D Needs from Oct 2004 AFPA Workshop entitled "Nanotechnology Workshop for the Forest Products Industry."

About the Author:
Maud Hinchee represents ArborGen LLC, Summerville, South Carolina, and is a member of AF&PA Forest Science and Technology Committee. ArborGen LLC is a partnership supported by more than 100 researchers and plant scientists from the United States, Brazil and New Zealand. Visit www.arborgen.com to learn more.

The Workaholic

By Barton Goldsmith, Ph.D.

If you are more comfortable at work than in any other environment, or if you feel as if you can't take a vacation, or don't have the ability to just turn off work for a few days, you may actually be a workaholic.

WHETHER IT'S ADDICTION, AVOIDANCE, OR AN OBSESSIVE-COMPULSIVE DISORDER, WORKAHOLISM IS HARMFUL TO ITS VICTIMS AND THOSE WHO ARE CLOSE ENOUGH TO FEEL THE FALLOUT. Additional signs can include using work as an escape, having your home become a "satellite office," and being unable to be at peace when you're not thinking about or doing work. An inability to relax or to enjoy your free time is another signal that you could be in the process of becoming a human-doing rather than a human-being.

Hard work and achievement are good things, but if they take the place of loved ones or even taking care of yourself, you need to take a deeper look at what's driving you. This includes using work to avoid personal or family issues.

For some, living to work may actually mean working to live. When struggling to make ends meet, working overtime at every opportunity is totally understandable. These are difficult situations, but to maintain good health, you need to build in some downtime. The difference between needing to work and workaholism lies in whether or not you can stop thinking about your job when you are away from it. Others who overwork may have a severe need to be perfect and feel that no one else can do the job as well as they can. Sometimes a workaholic may fear losing a job, so he or she puts in the extra effort to ensure job security.

There are occasions when overwork can be beneficial. If you are healing from an emotional wound, trying to build a nest egg, or fighting bad habits, concentrating on work can be a good idea. Just make sure that you keep some balance in your life.

Workaholics Anonymous (www.workaholics-anonymous.org) has a web site where you can take a test, get some basic information about support groups, and learn about some things you can do to dial your work life back a little bit. A couple of good tips for dealing with this issue include taking long weekends and vowing during time off not to tackle any work-related projects. Another tip is to make your personal time a sacred space where you can only do things for yourself or your loved ones.

As issues go, this may not be perceived as the worst thing in the

world. But I have seen it ruin numerous relationships and families. I have also met many very successful people who felt alone in the world because so much of their time was spent at their businesses instead of with those they love.

Culturally, we tend to honor hard work, and most people feel that it pays off. But in the end, if it replaces the more important things in life, like relationships, you end up with less. CI

About the author

For more than two decades, Dr. Barton Goldsmith has helped Fortune 500 companies, educational institutions, and government organizations worldwide to help them develop creative and balanced leadership. He is a highly sought-after keynote speaker, business consultant and author. His columns appear in more than 500 publications, including the Chicago Sun-Times, the Detroit News, and the Los Angeles Business Journal. Considered an expert on small business, he has spoken worldwide to groups of 10 to 5000, and is in high demand for keynotes, training and consulting. He may be contacted through his web site or at (818) 879-9996.

This article was originally published in the July 4, 2007 edition of Ahead of the Curve, a weekly newsletter published by TAPPI.

You can't play the game if you don't know the language

Ken Patrick

Since my last Biz-Speak column more than a year ago, some new terms have crept into the business vernacular, and are being heard more frequently around less frequent pulp and paper industry events these days.

FOR THOSE WHO KEPT UP WITH THE SERIES FROM BS 101 THROUGH THE GRADUATE-LEVEL INSTALLMENT, THE FOLLOWING BS PAPER360º EDITION WILL HELP POLISH YOUR SKILLS AND KEEP YOU IN TUNE WITH THE LATEST OFFICE DISCUSSIONS AND BS NETWORKING SESSIONS ANYWHERE AROUND THE INDUSTRY.

These terms will prevent BS slippage and keep you in the loop with other BSers. Just a few minutes of study will hone your Biz-speakmanship and have you ready to BS at a moment's notice. You might want to make a copy of these latest terms and keep it as a study reference on the seat beside you while putting in some windshield time in the morning rush hour traffic.

1. **FBI:** Faith-Based Intelligence. A top-down management approach in which high level executives already know all the answers and need only the intelligence to support them, e.g., "just give me the logic behind my answer."

2. **DWY:** Driving while Yakking. Common cell phone phenomenon during rush hour traffic.

3. **DWT:** Driving While Texting. Similar to but more dangerous than DWY. The dark side of DWY.

4. **Free Wheeling:** Spending more time in traffic manipulating a Blackberry wheel than your car's steering wheel.

5. **Bobbleheading:** The nodding effect resulting from alternately looking at a Blackberry screen in your lap and someone (a spouse or business associate) talking to you from across a table, such as in a restaurant. Can be mistaken for agreement or paying close attention, in which case it is more accurately called yessing.

6. **Voodoo Statistics:** The art of twisting bad data or information to make it look good, e.g., "This year's loss represents a 50% improvement over last year's loss. Things are turning around in the paper industry."

7. **Back-Sourcing:** When outsourcers fail to deliver quality, service or cost effectiveness, companies will bring the job back in-house, e.g., "It's time to back-source this one, because we've lost control of what we're doing."

8. **MBWA:** Management by Walking Around. Wandering around an office asking employees what they're working on, how it's going, who the person in the office next door is, etc.

9. **Deck:** A reference to a PowerPoint "slide" show, e.g., "There were only 10 slides in the deck, but the presentation lasted more than an hour."

10. **50-50-90 Rule:** A variation of Murphy's law. Given a 50-50 chance of things going right, they'll go wrong 90% of the time.

11. **Hot Desking:** A practice by workers (particularly visiting outsource workers and newer Back-Sourcing employees) who have no permanent workstation or desk and are assigned temporary workspace based on availability and need. The official corporate term is "location independent working." Among workers it's known simply as "homeless."

12. **Meeting Moth:** An executive who flits from meeting to meeting, but seldom participates in or acts on the items discussed in them.

13. **Benchmark:** An objective assessment of how bad something really is so that further deterioration can be more accurately measured and blame properly placed.

14. **Windshield Time:** Time spent, generally in heavy traffic, commuting to and from work. "I had some really intense windshield time this morning."

15. **Desktime:** Time between commuting and meetings available to do actual work at your desk, roughly 5% of a typical employee's work day.

16. **Bleeding Edge:** Just beyond cutting edge.

17. **Locked Tool Box:** A reference to a company or organization that has the right tools, systems, equipment, etc., but lacks skilled employees to put them to good use.

18. **Mahogany Row:** A reference to those sections of an office building or floor where upper executives reside, i.e., offices that contain desks and furniture made of mahogany or other expensive dark wood, compared with cubicles having light colored Formica covered bench desks.

19. **Bulletize:** Use of bullets by people unable to think--or more specifically to write--in complete sentences.

20. **Word-of-Mouse:** A reference to the use of the "Tell a Friend" button at the top of some web pages.

About the Author

Ken Patrick is senior editor of *Paper360°*. Contact him at kpatrick@tappi.org. This edition of Biz Speak was originally published in Paper360°'s special June-July Summer "360" list issue. Check out the entire issue, including the complete results of the Reader Response Survey, at www.paper360.org.



Racing to a Stronger Tomorrow is the theme of TAPPI's 2007 Corrugated Packaging Division Conference to be held October 29 - November 1, 2007 at the Indianapolis Convention Center and RCA Dome in Indianapolis, IN. The event will kick off with the popular Corrugated Classic Golf Outing followed by the Opening Reception on Monday evening October 29th. TAPPI is offering a special discount to box plants this year. The special price of $1095 will be extended to an unlimited number of box plant employees from the same location. Technical program topics from Tuesday will be repeated on Wednesday so multiple people can attend sessions on different days for this one low fee. There is also a wide variety of topics and activities for all attendees who will attend the full conference.

Space is still available for the 13th Annual Corrugated Classic Golf Outing at the Purgatory Golf Club. Your round of golf will include a box lunch, free drinks and golf cart. There will be transportation to the course from the Westin Hotel. Visit www.tappi.org/correxpo for details and an application.

Back by popular demand, Joel Weldon will deliver two separate keynote addresses. Joel has been bringing business and industry leaders new perspectives on leadership, sales, customer service, and personal improvement for over 30 years. He has been hired by more than 2500 groups, from all across North America, to energize audiences and turn ideas into action.

On Tuesday, October 30th Joel will be delivering his speech "The Invisible Horses" (How Change Brings You Opportunity); this opening session will help you open your thinking to new ideas and get maximum benefits out of today's breakout sessions. You'll learn how best to bring these new ideas back with you to your organization and get people on your team to embrace them. You'll see how fast change is happening and how you can best adapt to these changes. And yes, you'll have a lot of fun in this opening session!

Joel will be speaking again on Wednesday, October 31st delivering another one of his world-famous motivational speeches, "Find Out What Everyone Else Is Doing…And Don't Do It" (How To Be Even More Innovative And Creative); this session will help you generate new ideas and new concepts to take back to your organization. You'll learn how to use 5 Trigger Words, 3 Idea Stimulators and a 4 Word Test to decide which ideas you should actually put into action. Your mind is full of amazing ideas … just begging to be released. This session will help you release them, and you'll have a lot of fun in the process!

The program will again concentrate on Corrugating/Corrugating Maintenance, Converting/Converting Maintenance and HRD/Safety. Several of the most popular presentations will be repeated from 2006, with improvements as suggested by attendees, and there will be new topics as well. The duration of each presentation will be extended to 40 minutes, which will allow for questions and more interaction with the instructors. Please plan to bring your problems and the experts will help you solve them! Click here for full descriptions of program topics. Presentation titles include:

CORRUGATOR/CORRUGATOR MAINTENANCE

Session Moderator, Jim Carbone, Harper Love Adhesives

- **Starch Make-up and Water Treatment**
  Presententers: Roman Skuratowski, Corn Products & Bob Lantz, Ringwood
- **Singlefacer & Glue Machine**
  Presenters: John Sofinowski, MarquipWardUnited, Joe Finke, MarquipWardUnited, Jack Wallace, Packaging Corp of America, Keith Lansdale, Packaging Corp of America
- **Liner and Medium Properties and Their Relationship to Corrugated Board**
  Presenters: Jeff O'Cull, Temple Inland, Pat Pochiro, International Paper, Paula Henderson, Temple Inland
- **Corrugated Board Quality Testing**
  Presenters: Jamie Adams, Weyerhaeuser Company, Carlton Mathews, Smurfit Stone Container, Dwyer Griffin, International Paper
- **Board Quality Analysis at the Corrugator Dry End**
  Presenters: Dave Vollick, Smurfit Stone Container & Chuck Shaffer, Weyerhaeuser Company
- **Heat Transfer on the Corrugator**
  Presenters: Steve Schmidt, Copar Corporation, Bob Montgomery, Cleaver-Brooks, Craig Machamer

CONVERTING/CONVERTING MAINTENANCE

Session Moderator, Steve Woodard, ARC International

- **Improving Productivity with pH Stable Inks**
  Presenters: Bob Cantu & Charles Hague, Sun Chemical
- **The Ink Metering Marriage: Anilox Rollers & Doctor Blades**
  Presenter: Jean Jackson, Allison Systems
- **The Fingerprint and it's Continuing Use on Every Job**
  Presenters: Cordes Porcher, Packaging Corporation of America, Scott Gilbert, Smurfit Stone Container Corporation
- **Impact of Equipment on Structural Design**
  Presenters: Rick Putch & John Harmon, Dicar Inc
- **Converting Equipment Maintenance**
  Presenters: Rick Croker & John Troyke, Gerogia Pacific Corp.
- **Manufacturers Glue Joint Best Practices**
  Presenters: Rhonda Nichols, International Paper, Frank Charbonneau & Annick Ensley, Smurfit Stone Container
- **Maximizing Box Compression Potential**
  Presenters: Dave Carlson, Fibre Box Association & John Rutherford, Temple Inland

HRD/SAFETY

Session Moderator, Scott Ellis, P Squared

- **The Value of Training**
  Presenter: Bill Baggett, Bates Container
- **Breaking the Cycle of At-Risk Behavior**
  Presenter: Gary Higbee, Higbee & Associates, Inc
- **Visual Standards for Best Practices, aka Building a New "Our Way"**
  Presenter: Les Pickering, P Squared

To compliment the "hands-on" small group sessions, several hot topics will be addressed in technical paper presentations on Thursday from 11:00 am - 12:30 pm. Paper topics include "Sheer Measurements to Detect Combined-Board Crushing Effects" by Roman Popil, IPST at Georgia Tech, and "Revisiting Paper Strength Measurements for Estimating Combined Board Strength" by Benjamin Frank of Packaging Corporation of America.

The popular What's New Technology Showcase session will also be held on Thursday morning. The Showcase will be comprised of nine select 10-minute presentations that will allow presenters to spotlight a product or service developed within the past two years. Following the What's New Session, Larry Montague, TAPPI President, will give a brief update on the association, and Steve Young, AICC President will give a report on the trip which AICC members recently took to China.

2007 CorrExpo includes a wide variety of products and services for everyone! Over 120 exhibitors have signed up to be a part of this great event. Limited space is still available, so please visit www.tappi.org/07correxpo for details.

At 1:30 pm (just prior to the exhibit hall opening) on Tuesday and Wednesday there will be 3 special presentations which have been added to the technical program this year. In addition to being a part of the technical program for all paid conference attendees, these 3 presentations are **FREE** to all box plant employees.

Presentations include:

1. Lean Manufacturing, Kirt Patel, Georgia Pacific Corporation
2. Robotocs, Dave Ahrendt, Alliance Machine Systems
3. Digital Printing, Phil Dempsey, Poteet Printing

The TAPPI Corrugated Division Technical Committees will again hold their lunch meetings this year. These committee meetings are open to anyone who would like to attend. The Fiscotec Committee meeting will be held on Tuesday and the Corbotec Committee meeting will be held on Wednesday. These committee meetings always provide a wealth of technical information and also offer a great way to get to know people in the industry with interests common to your own. For a description of each of these committees please visit www.tappi.org and click on Information For Corrugated Packaging in the left column of the home page. The Supplier Advisory Committee will meet at 5:30 pm on Tuesday, Oct 30th. Additional information on the HRD/Safety Committee, the End User Committee and the International Committee will be available at the conference. Also, please watch for upcoming "ad hoc" committee projects which will be available to all members regardless of their committee affiliation.

As you can see, from the first tee time at the Corrugated Classic Golf Outing on Monday, to the Technical Paper Session on Thursday, this will be a value packed conference for everyone who attends! Don't miss out on this wonderful networking and educational opportunity! For any questions please contact Kristi Ledbetter at + 770-209-7319 or kledbetter@tappi.org.

