Purpose:

Evaluate 3 carton boards 2C300B, 2C305C and 2C305M for physical properties.

Background:

Folding carton board is used for packaging therefore its optical properties are important. Brightness is the relative reflectivity at 457 nm and reflects the use of optical brighteners and bleaching. The color is described the CIE LAB* system where L* is the measure of lightness (+) or darkness (-), a* the measure of redness (+) or greenness (-), b* is the amount of yellowness (+) or blueness (-). Mechanical properties are important for packaging, these include tensile strength, bending resistance. Tensile testing also produces a measure of the ductility of the sample measured as the stretch to failure and the quality of the materials reflected by the tensile stiffness value. The bending resistance is measured as the amount of force required to deflect a test specimen of chosen fixed dimension to an angle of 15 degrees. This value is directly the product of the tensile stiffness times the caliper squared. The burst strength is a combination of the tensile strength and the surface ductility and so is a side dependent test. Out of plane tear is largely influenced by fiber pull and is a combination of fiber length fiber quality and bonding.

About IPST Paper Analysis Laboratory:

Paper Testing at IPST has over 2800 square feet of lab space dedicated to address any paper, board, and specialty product testing needs in areas of strength, optical, surface, and structural properties. In addition to conventional TAPPI method testing capabilities, the Paper Testing group can provide special services in the areas of environmental simulations and accelerated aging. Environmental chambers cover high and low temperature and humidity conditions. Unique capabilities include precision paper grinding or sheet splitting to produce specific thickness sections, score cracking of linerboards, needle abrasion testing to predict relative slitter and knife blade wear caused by abrasive components in both base sheet and coating materials, nondestructive in-plane and out-of-plane (Z-directional) ultrasonic testing, optical 3D Moiré surface topography for the measurement of curl or cockle. Our labs also offer the latest automated capabilities for real time hygroexpansive response

measurements, and horizontal plane static and kinetic coefficient of friction determinations. Humidity and temperature conditions are monitored and tracked continually to ensure proper standard TAPPI conditions of 23°C and 50 % RH.

Data from the IPST Paper Analysis Laboratory have been validated through IPST participation in the Collaborative Testing Services Inc., and PAPRICAN Paper and Pulp Monitor programs. Internal checks by comparison of selected samples with their historic data and regular instrument calibrations using standards are standard procedures. This ensures that the equipment, methods and results are consistent with correct industry practice.

Methods:

Standard Tappi methods are used in most tests unless otherwise specified. Measurements consist of 6 or more repeats per sample.

Moisture - samples were tested as supplied, removed from their Al foil sealed packages and tested immediately**.** About 10 grams of each sample was cut into small pieces and placed in 6 separate Al cans for placement in an oven set to 105 degrees C. Samples were kept in the over for over 48 hours. The percent moisture was calculated as

% moisture = (wet weight – dry weight)/(wet weight – tare weight) x 100

Brightness, Lab*– a Technidyne TB-1c spectrophotometer was used to measure according to the ISO method. 6 repeat measurements were made for each sample.

Tear – a Messmer Digi-Tear instrument was used sngle plies tested at a time, pendulum C selected for the carton board. 5 reading in MD and CD were made for each sample.

Bending Resistance, Taber – a Taber Model 150-E bending resistance instruments with range 3 (roller down, 500 unit weight on) 5 reading in MD and CD for each sample.

Burst – an L&W board burst tester was used 5 reading for each side of each board

Tensile testing – an Instron Model 1122 UTM with series IX software was used, sample strips were 15 x 160 mm. 6 reading were made in MD and CD for each sample.

Data:

Most measurements consist of at least 6 repeats or more whenever possible.

A comparison of significant differences between samples can be gleaned through comparison of the results with error bars representing the 95% confidence intervals of the results from repeated measurements for each sample.

Table 1. Summary of the optical testing for both sides of the 3 board samples.

	top side optical properties							uncoated side optical properties						
Sample ID	Brightness		L*	a*	b*	ASTM	CIE	Brightness		L*	a*	b*	ASTM	CIE
		c.i.				Whiteness	Whiteness		c.i.				Whiteness	Whiteness
305M	83.17	0.28	93.89	0.18	1.47	77.18	78.47	72.04	0.32	92.56	-0.61	8.34	40.06	42.82
305C	82.56	0.35	93.64	0.47	1.56	76.14	77.44	27.88	0.49	76.17	4.26	28.96	-40.77	-108.01
300B	85.21	0.51	94.5	0.26	1.24	79.71	80.96	81.7	0.07	94.42	0.47	3.68	66.6	69.44

Table 2. Summary of the moisture and tensile test data. The "c.i" are the confidence intervals for each corresponding average value.

Sample ID	Moisture		Tensile tests											
		c.i.	Strength MD	c.i.	Stretch MD	c.i.	MD Stiffness	c.i.	Strength CD	c.i.	Stretch CD	c.i.	Stiffness CD	c.i.
305M	6.83	0.06	16.862	0.335	2.458	0.069	1269.99	12.898	9.134	0.186	5.925	0.249	555.604	11.636
305C	7.19	0.04	16.66	0.215	2.267	0.062	1237.453	8.686	9.951	0.143	5.933	0.162	590.374	5.124
300B	6.56	0.05	16.58	0.354	2.771	0.113	1183.784	13.315	9.694	0.089	5.729	0.153	579.003	9.889

Table 3. Tear Burst and bending resistance results summary.

Sample ID	Tear (mN)				Burst (kPa)				Taber bending resistance (gm-f)			
	MD	c.i.	CD	c.i.	coated side	c.i.	uncoated side	c.i.	MD	c.i..	CD	c.i.
305M	2361	536	2671	387	747.61	20.79	665.89	57.02	56.3	1.3	26.2	0.6
305C	3546	458	3110	214	762.53	35.28	613.16	45.16	64	2.1	29.2	1.1
300B	3110	398	2539	293	733.63	16.27	677.7	24.16	48.5	0.6	24.4	0.8

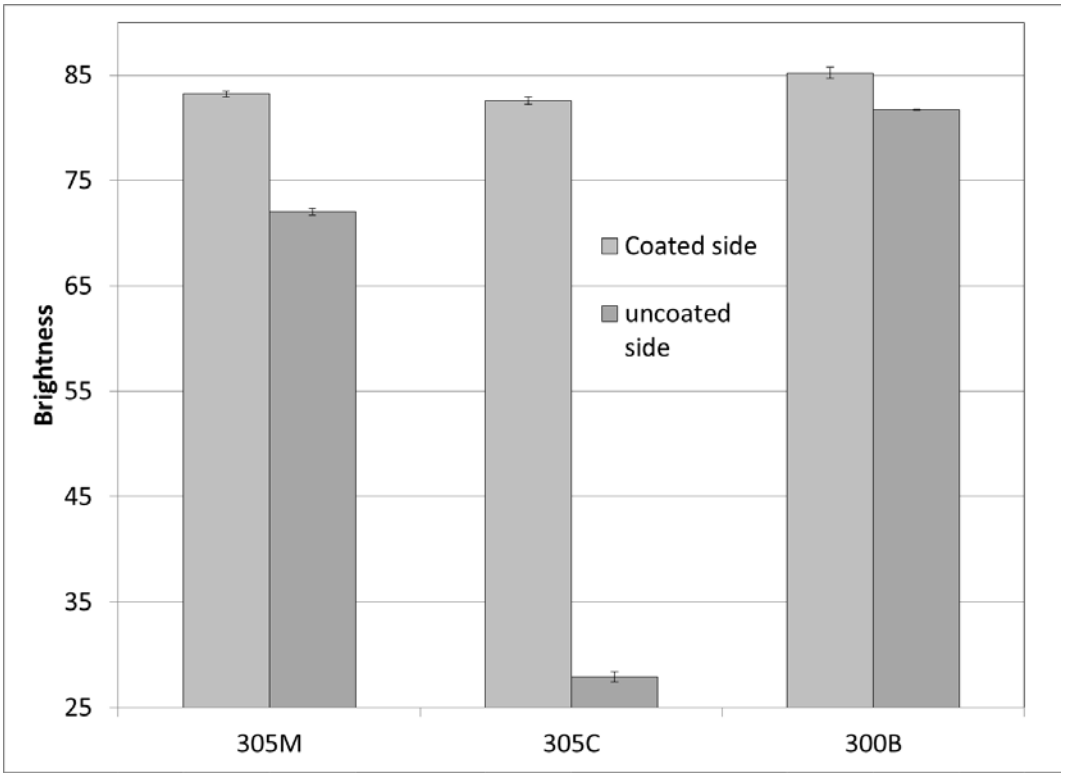

Figure 1. Comparison of Brightness values for both sides of each sample. #00B is the brightest sample.

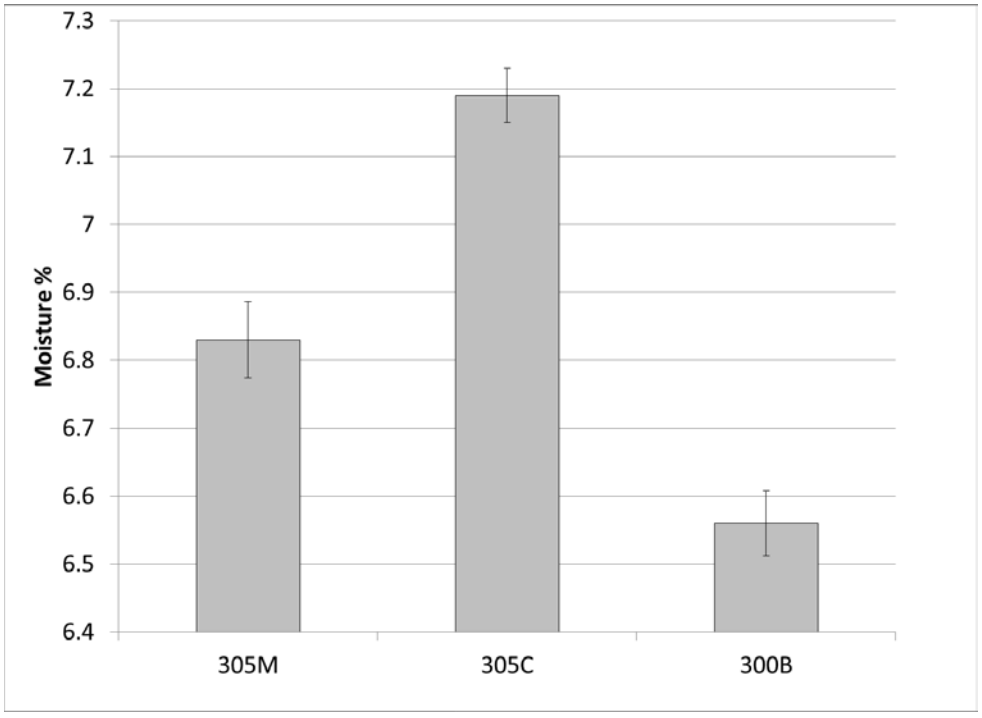

Figure 2. Moisture level comparison, 300B is the driest sample.

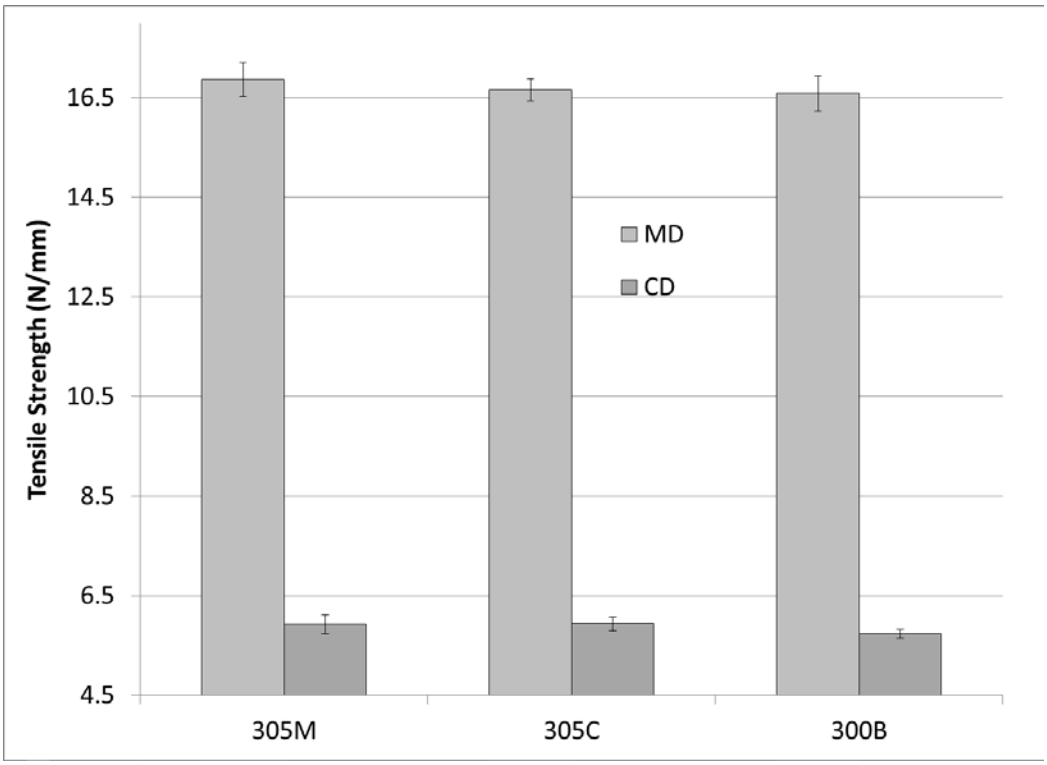

Figure 3. Comparison of tensile strengths, the differences are insignificant.

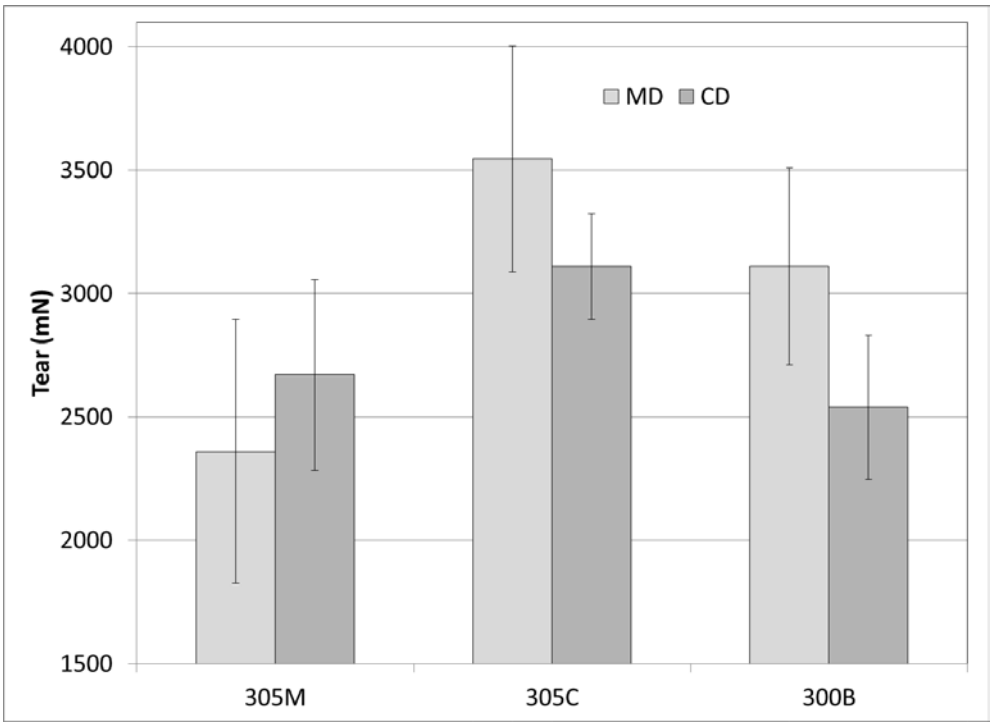

Figure 4. Comparison of tear strengths. Sample 305M is weaker than 305C.

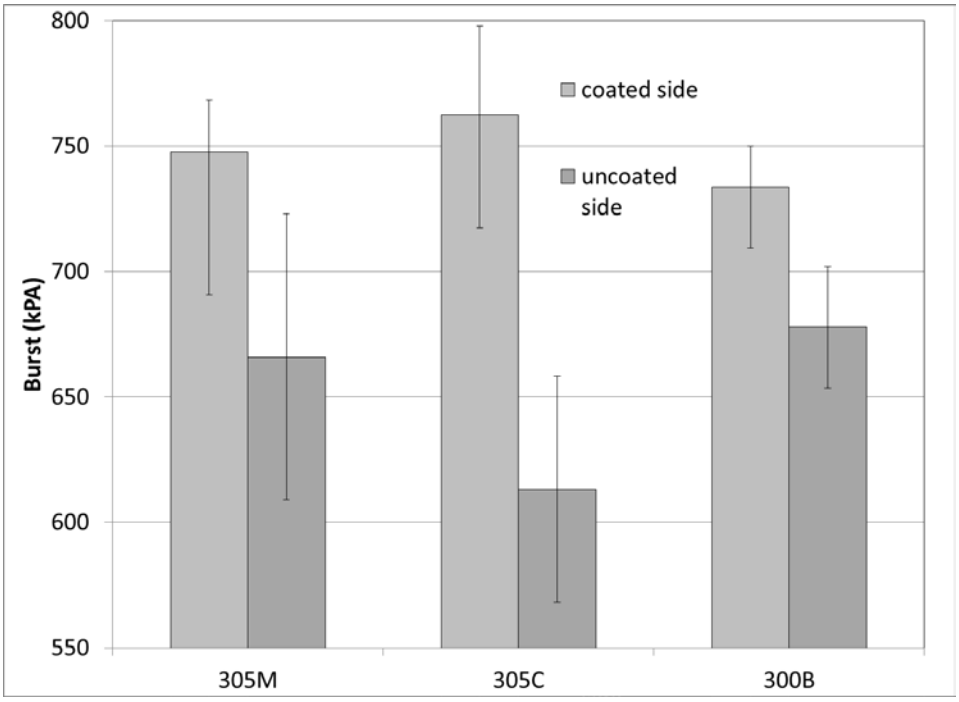

Figure 5. Burst comparison, sample 305C uncoated side has a significantly lower burst strength than 300B.

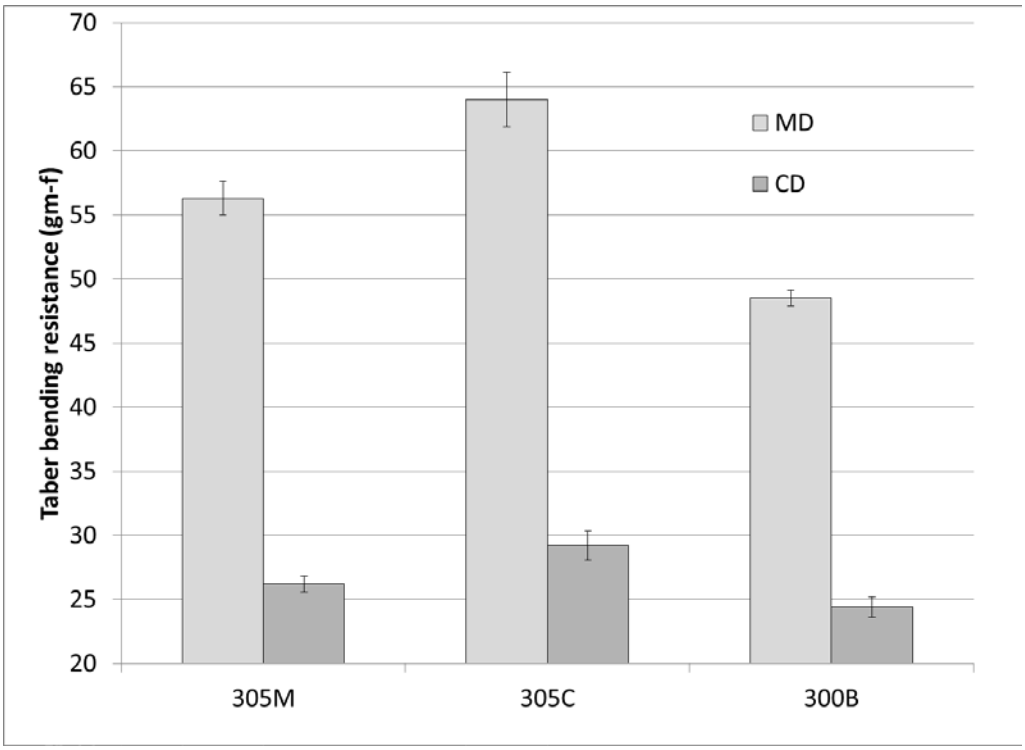

Figure 6. Taber bending comparison, 305C is the stiffest.

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