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REPULPABILITY OF WAXED CORRUGATED BOARD

Project 3900

A Report

to the

FBA/AF&PA REPULPABLE WAX VOLUNTARY
STANDARDS TASK FORCE

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Repulpability of Waxed Corrugated Board

Introduction

This project was sponsored by the FBA/AF&PA Repulpable Wax Voluntary Standards Task Force to develop a standard procedure for evaluating repulpable wax in waxed corrugated board. The scope of the project was outlined in Dr. Sujit Banerjee's letter to Otto Kroeschell, dated August 4, 1994 and agreed to by Mr. Kroeschell's response of August 10, 1994. During the course of the project changes were made to the procedures. These changes were necessary to make the procedures workable in the IPST laboratory facilities. They were agreed upon by Mr. Kroeschell and/or by Tom Santelli, Chairman of the task force committee. Following is a comparison of the proposed procedure and the procedure actually used.

Procedure	Proposed	Actual
No. samples tested	7	9
Pulper		
Type	British Disentegrator	British Disentegrator
Revolutions	50,000 or as specified by CKPG	75,000
Temperature	140° F	130°F
pH	8.5	8.5
Screening		
Type	Bauer-McNett Classifier	Summerville Fractionator Flat Screen
Coarse Screen	10 mesh	None
Fine Screen	48 mesh	.010" slotted
Temperature	140° F	120-130°F
Handsheets		
Sheet Mold	British	British
Temperature	140° F	130°F

Objective

Develop a test procedure to determine the repulpability of waxed corrugated board.

Conclusions

- The repulping procedure as demonstrated here can identify specific repulping concerns of a waxed corrugated board sample. This includes wax build-up on equipment, screening and separation concerns, sheet appearance, stickiness, and build-up in white water systems.

- More information has to be developed and more testing done before the procedure can be used as a yes/no criterion for waxed board repulpability.

- It appears that any repulped corrugated board containing an appreciable amount of wax will cause wax build-up problems on plant equipment, regardless whether the wax is repulpable or non-repulpable.

- Some repulpable waxes build up as colloidal dispersions in white water systems. Ways would have to found to agglomerate them if they are to be separated by mill screening or liquid cyclone cleaning systems.

- Sheet appearance and stickiness vary with different repulpable waxes.

Recommendations

- A program should be entered to develop criteria that will determine whether or not a waxed corrugated board is to be considered as repulpable. This should include an extensive study of mill processing capabilities.

- The procedure as described here can be expanded to larger scale equipment in the IRF of IPST. This would include a larger flat screen and use of the Formette Dynamique to produce handsheets for evaluation and testing. The Formette would also allow for the study of white water recycle. A project proposal for this work has been prepared and is being submitted to the CKPG for their consideration.

- A method should be developed to determine the wax content of white water at levels of 1 to 50 ppm.

Summary

- The procedure used in this study is included as Attachment 1 to this report.

- Table 1 is a data summary of all the tests. It includes sample identification and description, experimental conditions, experiment material balances, and handsheet evaluation results.

- Table 2 is the subjective evaluation summary of each board sample. Attachment 2 of this report is a description of the evaluation criteria.

- Following are the results of the evaluation:

  Build-up - In British disentegrator type of pulping, wax forms into crumbly particles that adhere to the walls of vessels and are very difficult to clean. This is true whether the wax is rated as repulpable or non-repulpable

  Screenability - Two pulps did not pass through the .010" flat screen very well.

  1) One pulp, 4046-116-2 containing a non-repulpable wax screened O.K. at low temperature (72°F) but not at high temperature (125°F).

  2) The other pulp (4046-116-9) did not break up in the disentegrator, because it came from a wet strength board.

  Stickiness - Based on handsheet sticking to blotter after drying. There was large variability between pulps, however, there was no apparent pattern based on wax content, type (repulpable or non-repulpable), and/or how applied.

  Handsheet Appearance - Based on wax spots, blotter stickies (pieces of blotter sticking to the handsheets), shives, and dirt. There was large variability between pulps, however, there was no apparent pattern based on wax content, type (repulpable or non-repulpable), and/or how applied.

  Wax Build-up in Screen White Water - Two repulpable waxes, 4046-116-3 and 4046-116-8 showed excessive build-up in the screen white water. The milkiness of the water indicated a colloidal dispersion. Methods have to be developed to determine the actual wax content of the white water.

Discussion

1. Bauer-McNett Experiments

Initial experiments utilizing the Bauer-McNett classification apparatus quickly revealed that this approach was not going to work. The Bauer-McNett screens are mesh screens designed to separate fiber based on length. Too much of the pulped samples were separated on the screens and only a small percentage passed through.

2. Trial Experiments

The experiments in columns 1 and 2 of Table 1 were simply "rehearsal" type experiments to test out the flat screen approach. They were run using cold water through the flat screen. They revealed that normally only a small percent of rejects would be retained even on the .010" screen. A coarse screen was unnecessary and would only serve to complicate the experiments. The experiments are included in Table 1 only because they provided an interesting comparison for sample 4046-116-2 containing a non-repulpable wax. When screened cold the pulp passed through the flat screen. It would not pass through when screened hot. The reported softening point of non-repulpable wax is reported to be between 120 and 130°F. It is possible that at the hot screening temperature, the partially softened wax forms a gelatinous network with the fibers so as to prevent passage through the screen.

3. Water Quality

Hot tap water was used for all experiments. Its analysis was as follows:

Identity	Concentration (ppm)	as carbonate (ppm)
Calcium	1.23	3.07
Magnesium	6.50	22.54
Hardness	-	25.61
as equivalent $CaCO_3$	-	29.84

The maximum temperature achievable out of the IPST hot water supply was 120-130°F. That is why this temperature was utilized for all experiments.

4. Wax Analysis

Wax contents of solid materials (board, handsheets, and screen rejects) were determined in accordance with TAPPI T405.

Attempts to analyze the whitewater samples (screen and sheetmold) for wax content by trichloroethane extraction were unsuccessful because the wax contents were too low to be measured. Consider that in the screening procedure, 24 gm of wax content pulp were screened with approximately 50 gallons of water. If all of the wax content (as high as 50%) went into the white water, the maximum possible wax content would be 50 ppm for the worst case scenario. It follows that normal wax contents in the white water would then be in the order of less than 25 ppm.

Attachment 1: Wax Repulpability Procedure

PULPING

1. Submit board sample for wax analysis.

2. Condition board in R.H. room at 72°F for 24 hours.

3. Determine moisture content of conditioned board.

4. Weigh out 24 +/- .5 gm of sample.

5. Soak overnight in 500 ml D.I. water (4 hr. minimum soak)

6. Add to British Disintegrator along with 1500 ml D.I. water that had been heated to 80°C. After mixing the temperature should adjust to approximately 55°C.

7. Use dilute sodium hydroxide solution to adjust pH to 8.5 +/- .2.

8. Wrap heating tape around disintegrator vessel.

9. Turn on disentegrator agitator and disintegrate for 75,000 revolutions. Check temperature occasionally and use Variac control on heating tape to maintain temperature at 55+/-3°c

10. At the end of the disintegrator cycle check temperature and pH.

SCREENING

1. Use Summerville (L&W) flat screen - .010" screen plate.

2. Use city water at 50-55°C.

3. Adjust hot water flow rate through screen to 2-3 gpm. Measure this rate accurately prior to the run.

4. Add the hot pulp from the disintegrator directly to the screen. Scrape off, as much as possible, the material sticking to the walls of the disintegrator and add this to the screen vessel. Qualitatively note the nature of the material sticking to the vessel walls.

5. Run for 20 minutes.

6. The accepts through the flat screen are caught on a 150 mesh wire screen.

7. Collect a composite sample of the water through the 150 mesh wire screen in accordance with the following schedule:

   a. 200 ml every 30 seconds for the first five minutes.
   b. 400 ml every 60 seconds for the remaining 15 minutes.

8. When the run is completed remove the accept fiber from the 150 mesh screen and transfer to a stainless steel vessel big enough to hold 6 liters. Add hot water to 6 liters - measure accurately. Determine the solids content to determine the amount of accepts through the .010" screenplate.

NOTE: The test sheet from the handsheet procedure below can be used for the solids content determination.

9. Place the stainless steel vessel and its hot slurry contents on a hot plate with agitator. Maintain at 55°C till handsheets below are completed.

10. Remove the screen plate from the screen apparatus. Scrape off as much as possible the rejects into a suitable sized beaker. Be sure to include the scrapings from the walls of the screen plate vessel. Qualitatively note the nature of the material sticking to the walls of the vessel.

11. Add water to the beaker, slurry the scrapings and determine solids by filtering and drying.

12. Submit accepts specimen, filter paper and all for wax analysis.

13. Withdraw 2000 ml of the screen white water composite and determine its solids content by filtering and drying. Determine total solids that went through the 150 mesh screen by multiplying the white water solids content by the measured flow rate for 20 minutes.

14. Submit a 1000 ml sample of the white water composite for wax content analysis.

HANDSHEETS

1. Follow handsheet procedure of TAPPI T205 using a British Sheet mold.

2. Use accepts from the slurry in the heated stainless steel vessel above.

3. Remove exactly 600 ml of slurry for the test sheet to determine slurry consistency.

4. The test sheet consistency can be used to calculate the weight of bone dry accepts through the flat screen.

5. Based on the test sheet consistency, calculate the volume of slurry to produce a 1.2 gm handsheet.

6. Add 55°C hot water to the sheet mold then add the calculated volume of slurry.

7. Prepare the handsheet in accordance with TAPPI T205.

8. Couch and press the handsheet at 50 psi for five minutes. DO NOT REMOVE BLOTTERS AFTER PRESSING.

9. Dry the handsheets, blotter and all, on a steam heated drum dryer with weighted felt cover at 15 psig (approximately 250°F)

10. When releasing the handsheet from the blotter, evaluate stickiness to the blotter based on a scale of 1 - 5: 1 is good - the sheet releases with very little resistance, 5 is bad - there is definite resistance. Note If pieces of blotter stick to the handsheet or if pieces of handsheet stick to the blotter, that should be considered in the rating.

11. Qualitatively evaluate the appearance of the handsheet. Look in particular for wax spots and blotter stickies. Also consider shives, dirt and other visible contaminants. Do not consider formation unless it can be related to the contamination.

Attachment 2: Repulpability of Waxed Corrugated Board

Evaluation Criteria

- Wax Build-up

  None or O.K. - Very little build-up noted on walls of vessels

  Bad - Severe wax build-up on walls of vessels.

- Screenability

  Passed - Most of pulp went through a .010" flat screen.

  Did not pass - A good portion of the pulp did not pass through a .010" screen.

- Sheet Appearance

  Based on visual examination of handsheet for wax spots, blotter stickies (pieces of blotter sticking to handsheet), shives , and dirt.

- Stickiness Rating

  Based on a scale of 1 to 5; 1 is least sticky, 5 is most sticky. Determined by how easily blotter peels from handsheet after they are dried together.

- Wax Build-up in Screen White Water

  Severe - A high percentage of filterable pulp solids ended up in white water.

  O.K. - A small percentage of filterable pulp solids ended up in the white water.

  Good - Very little filterable pulp solids ended up in white water.

  NOTE: Does not include non-filterable solids such as dissolved solids or colloidal particles.

Table 1
Repulpability of Wax Content Board - Data Summary

Sample		1	2	3	4	5	6	7	8	9	10	11	12
	Identification	4046-116-1	4046-116-2	4046-116-1	4046-116-2	4046-116-3	4046-116-4	4046-116-5	4046-116-6	4046-116-7	4046-116-8	4046-116-9	4046-116-9
	Supplier	G.P.	G.P.	G.P.	G.P.	PCA	Mead	Weyerhauser	Weyerhauser	Mobil	Mobil	Int. Pap.	Int. Pap.
	Board Type	56/40C/56	56/33/56	56/40C/56	56/33/56	42/26/42	42/26/42	33/26/33	69/33/69	120 lb	120 lb	Wet Strength	Wet Strength
	Wax Type	None	Nonrepulpable	None	Nonrepulpable	Repulpable	Unknown	Repulpable Citgo	Repulpable Recycle Wax	Repulpable MTW 400	Repulpable MTW 398	Repulpable Proprietory	Repulpable Proprietory
	Wax Application	N/A	Impregnated & Curt. Coated	N/A	Impregnated & Curt. Coated	Hand Dipped	Curtain Coated	Curtain Coated	Impregnated (cascaded)	Impregnated	Curtain Coated	Proprietory	Proprietory
	Wax Content, %	0.8	14.1	0.8	14.1	40.9	12.4	10	33.5	32.4	13.8	1.3	1.3
	Cond'd Moisture Cont.,%	8.2	8.9	8.2	8.9	6.7	9.0	6.2	5.0	6.4	6.9	7.8	7.8
	Cond. Sample Wt, gm	26.042	26.024	26.488	26.236	25.843	26.528	25.585	25.338	26.071	26.446	25.749	26.219
	B.D. Sample Weight, gm	23.907	23.708	24.316	23.901	24.112	24.140	23.999	24.066	24.402	24.622	23.740	24.174
Disentegrator	Experiment Ident.	4046-121	4046-122	4046-123	4046-124	4046-125	4046-126	4046-127	40460-128	4046-129	4046-130	4046-131	4046-132
	Disentegrator Temp. °C	57	52	55	52	59	56	57	53	55	58	54	54
	pH Start	8.73	8.46	8.45	8.52	8.46	8.50	8.60	8.50	8.60	8.71	8.5	8.42
	pH end		8.31	8.27	7.93	8.30	7.57	7.98	-	7.58	7.76	7.7	7.59
	Revolutions	105650	103675	75025	77325	75000	77225	75000	77725	75003	75500	750050	75050
Screen	Screen Plate, in	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.006	0.010
	Screening Temp. °C	22	22	54	51	50	55	51	53	50	52	51	49
	Flow, gpm	2.56	2.02	3.12	2.67	2.83	2.62	1.91	1.68	3.00	2.65	2.37	2.89
Screen Mat'l Bal.													
In, gm	Bone Dry Sample	23.907	23.708	24.316	23.901	24.112	24.140	23.999	24.066	24.402	24.622	23.740	24.174
Out, gm	Screen Rejects	0.112	0.501	0.097	11.230	0.075	0.653	0.592	0.766	0.338	0.812	5.362	4.93
	Screen Accepts	19.05	17.19	19.23	7.90	13.34	18.28	19.11	17.75	17.83	15.81	15.82	17.443
	Screen W.W. Solids	-		1.82	2.02	6.85	2.58	0.72	0.13	1.14	7.92	1.79	1.09
	TOTAL	19.16	17.69	21.15	21.15	20.19	21.51	20.43	18.65	19.30	24.54	22.97	23.46
Wax Balance													
In, gm	Board	0.19	3.34	0.19	3.37	9.86	2.99	2.40	8.06	7.91	3.40	0.31	0.31
Out, gm	Screen Rejects			0.016	1.572	0.044	0.545	0.496	0.643	0.171	0.433	0.080	
	Handsheet			0.538	0.300	0.414	0.329	1.368	2.006	2.906	0.063	0.396	
	TOTAL			0.554	1.872	0.458	0.874	1.864	2.649	3.077	0.496	0.476	
Handsheet Eval.	Stickie Rating			1	3.5	2	2	1	2	4	2	3	5
	Appearance	Clean	Numerous Wax Spots	Clean	Clean	Shives	Wax Spots & Shives	Numerous Wax Spots	Minor Wax Spots & Small Shives	Shives Blotter Stickies	Shives	Wax Spots & Blotter Stickie	Minor Wax Spots & Blotter Stickies

Table 2
Project 3900 - Evaluation of the Repulpability of Waxed Corrugated Board

Identification	4046-116-1	4046-116-2	4046 -116-3	4046-116-4	4046-116-5	4046-116-6	4046-116-7	4046-116-8	4046-116-9
Source	GP	GP	PCA	Mead	Weyerhauser	Weyerhauser	Mobil	Mobil	I.P.
Board Type	54/40C/56	56/33/56	42/26/42	42/26/42	33/26/33	69/33/69	120 LB Corr.	120 LB Corr.	Wet Strength
Wax Type	none	Nonrepulpable	Repulpable	Unknown	Repulpable	Repulpable	Repulpable	Repulpable	Repulpable
Wax Application	None	Impregnated & Curtain Coated	Hand Dipped	Curtain Coated	Curtain Coated	Impregnated (cascaded)	Impregnated	Curtain Coated	Proprietory
Wax Content	0.8%	14	41	12.4	10	33.5	32.4	13.8	1.3
Wax Build-up	None	Bad	Bad	Bad	Bad	Bad	Bad	Bad	O.K.
Screenability	Passed	Cold - O.K. Hot - Did not Pass	Passed	Passed	Passed	Passed	Passed	Passed	Did not Pass Flakes
Sheet Appearance	O.K.	Cold- Wax Spots Hot - Blotter Stickies	Shives Blotter Stickies	Minor Wax Spots, Shives & Dirt	Wax Spots	Shives & Dirt Minor Blotter Stickies	Blotter Stickies Shives & Dirt Waxy Feel	Minor Wax Spots	Shives & Dirt Blotter Stickies
Stickiness Rating	1	3.5	2	2	1	2	4	2	4
White Water Build-up	O.K.	O.K.	Severe Cloudy W.W.	O.K.	Good	Good	O.K.	Severe Cloudy W.W.	O.K.

VOLUNTARY STANDARD - PART 1 - FIBER YIELD

1. Obtain a sample representative of the material to be evaluated. Normally this will be in the form of finished, and possibly used, corrugated containers. From this sample select enough area to provide 50 g of material for test. Selection should be as representative as possible of the material as a whole.

2. Cut selected sample material into approximately 1x1 inch pieces. Determine the moisture content [TAPPI T 412] and wax content [TAPPI T 405] and from this determine the amount of oven dry (OD) fiber charged.

3. Firmly fix a circular coupon of steel foil to the bottom of the cylinder of a British Disintegrator [TAPPI T 205], The coupon should be of approximately the same diameter as the disintegrator stirrer blades, rigid enough to withstand the agitation and of known mass and area. (see attached figure for one possible means of accomplishing this) Weigh the coupon to the nearest mg.

4. Place 24 OD g of the sample material in the disintegrator and add 2L of deionized water whose hardness has been be raised to 80-100 ppm with calcium chloride. Heat the water to 135° F.

5. Adjust the pH if necessary to 7 with diluted acid or base, and disintegrate for 75,000 revolutions, maintaining 135° F by placing the disintegrator in a water bath or heating mantle held at that temperature.

6. Charge the hot, disintegrated slurry to a laboratory vibrating flat screen, equipped with a screen plate with 0.010" slotted openings, flush with 2 - 3 gpm of tap water, heated to 130-135° F, for 20 minutes, catching the accepts which pass through the screen in a fine mesh (150 to 200 mesh) screen box. (Collect fines ?)

7. Either place the accepts from the screen box into a large beaker or pail, dilute to a known volume with water heated to at least 130°F and determine the consistency [TAPPI T 240] or filter the entire amount through a Buchner funnel, press and dry in the oven so as to accurately determine the mass of accepted solid material. Air dry and determine the moisture content [TAPPI T 412] and wax content. [TAPPI T 405] Determine the amount of fiber accepted. This amount divided by the amount of fiber (not wax) charged (step 2.) will represent the potential yield of the coated or treated board to be evaluated.

For example: assume that the sample material contains 30% wax and 10% moisture. Thus 26.7 g of sample material should have been charged [24÷(1-0.1)] and this contains 16.8 g of OD fiber. [24x(1-0.30)] If the amount of material accepted after screening is 25 g and it contains 10% moisture and 32% wax, it contains 15.3 g of fiber, [25.4x(1-0.1)(1-0.32)] this gives a yield of 15.3/16.8 or 91% and this is acceptable.

VOLUNTARY STANDARD -PART 2 - TEST PROTOCOL

1. Obtain a sample representative of the material to be evaluated. Normally this will be in the form of finished, and possibly used, corrugated containers. From this sample select enough area to provide 10 lb of material for test. [See 3. below for exact quantity to be charged.] Also necessary will be 90 lb of untreated or uncoated corrugated board (OCC) from the same base material that has been treated or coated.

2. Cut selected sample material into approximately 7x15 inch pieces with a suitable apparatus. (A power band saw has performed effectively.) Determine the moisture content [TAPPI T 412] and wax content. [TAPPI T 405]

3. Selection of the charge will depend upon the capacity of the laboratory pulper to be used. Pulping is to be carried out at 3% consistency. The charge will consist of 10% by weight of the material to be tested and 90% of the untreated or uncoated corrugated board, preferably taken from boxes. Calculate the percentage of wax charged. [Total mass charged x wax content x % wax in test material] Sparge the pulper with hot water and/or steam to bring the equipment near or above the desired temperature. Charge the pulper and water and with live steam or by other suitable means raise the temperature to 135° F. With dilute acid or alkali adjust the pH to 7. Pulp for 15 minutes. (Note: For some laboratories this may not be the correct time. Note whether the sample has essentially been well defibered. If the laboratory has not performed these test previously, it would be well to make a pilot run on the untreated or uncoated OCC alone to determine the proper time.)

4. Repeat 3. until sufficient material has been obtained for the following steps. Normally this will require three repetitions.

5. Combine the pulp from the several batches and dilute to 1% consistency with water heated to 135° F. Adjust the pH to 7. Circulate the resulting slurry, maintaining the temperature, through a suitable laboratory or pilot plant scale pressure screen equipped with a screen basket with 0.0625" holes at a volumetric reject rate of 10% of the feed rate. Determine the amount of rejects, air dry and determine the wax content.[TAPPI T 405]

6. With the accepts from 5. repeat step 5. through a screen with basket with 0.010" slots, again maintaining the temperature, pH, consistency and the 10% reject rate. Determine the amount of rejects, air dry and determine the wax content. [TAPPI T 405]

7. Finally recirculate the accepts from 6. through a reverse centrifugal-type cleaner, again maintaining the temperature, pH, consistency at the pressure differential specified for the cleaners being used. Determine the volumetric reject rate and record.

Determine the amount of rejects, air dry and determine the wax content. [TAPPI T 405]
Report the total percentage of wax of that charged[step 3.] which has been removed in steps 5., 6. and 7.

8. From the accepts from 7. form handsheets according to TAPPI T 205 with the following conditions:

The slurry should never be allowed to cool below 130° F.

Maintain the water to be used for the sheet formation at 130 -140° F, initially and throughout recirculation.

Form and discard six standard (1.2 g) handsheets, recirculating the water, accept the seventh and succeeding handsheets until the number required for the tests have been made.

Dry to 7% moisture content on a drum dryer maintained at >250° F

Test the handsheets [TAPPI T 220] for

Basis Weight, Caliper, Apparent Density
Slide Angle or Coeff. of Friction [TAPPI T 815 or 816]
Tensile Energy Absorption, (TEA) [TAPPI T 494]
Short Span Compression (STFI) [TAPPI T 826]
Bursting Strength
Laboratory Flat Crush (Concora or CMT) [TAPPI T 809]
Scott Bond or Internal Bond Strength [TAPPI T 833 or T 541]
Water Absorption and Penetration [to be determined],

using the procedures referenced in TAPPI T 220 where not specifically designated above.

9. Calculate the indexed strength tests, (TEA, SCT, Burst, CMT) i.e test result/ basis weight. Report those results, the values of the other tests, standard deviations, the amount of material rejected in each cleaning stage and its wax content, the volumetric reject rate used in step 7.,any observations of deposition in any stage of the process, the appearance of the handsheets and any deviations from this procedure.

8. Repeat 4. through 7. for a second 24 g of the selected sample. Thus 48 g of sample will be evaluated.

9. Remove the coupon (step 3.) from the disintegrator, wash with a gentle stream of water, air dry and weigh and determine the deposition of wax, if any, per unit area . This will determine the deposition from the two pulpings. The allowable maximum deposition will be determined at a later date.

10. Determine and report the minimum yield. (average of the two determinations)

11. Throughout the procedure (steps 5. and 6.) look for deposition on the walls of the vessels and the screens. Note in the report the presence or absence of deposits .

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DRAFT!!

AFPA/FBA
Voluntary Standard for Repulping and Recycling Treated Corrugated Fiberboard

PREFACE

The disposal of wax treated corrugated by grocery stores and other end users has been a financial and logistical annoyance. While treated corrugated containers are the most practical and cost-effective way to ship produce, meats, seafood and other items, certain treatments have made repulping difficult. It is desirable from both fiber source and environmental standpoints to facilitate the development of technology, the use of which would create treated corrugated which may be repulped using current mill technology.

The corrugated products industry recognized that the solution to this problem should be industry-wide, primarily because corrugated treated by a particular company cannot be effectively identified at the mills which recycle corrugated. Different treatment systems have had different impacts on repulping processes and some have been considered highly detrimental by mill operators. Therefore impediments will remain to widespread acceptance of new and more repulpable treatments by the end users and the customers of the corrugated industry.

Several industry companies offered to share their research in connection with repulpable wax treatments for corrugated boxes, as well as data on repulpability, box performance and the like. These companies believed they had developed suitable formulations for the various coating techniques used in corrugated box plants and they were willing to publicly discuss this information with others within the industry to achieve an expedited solution to this traditional dilemma of non-repulpability for waxed boxes.

To determine interest in this matter, an informational meeting was held for industry marketing and technical representatives. The nature of the industry problem was discussed in general terms, and the consensus of the group was that an industry solution would be appropriate and necessary.

To address and evaluate the technical as well as the educational and marketing aspects of the proposals, a joint committee of the Fibre Box Association and the American Forest and Paper Association was formed. After numerous meetings, numerous tests and legal review, the committee developed the draft voluntary standard attached hereto. It is a non-product-specific standard, which creates a new grade of waste paper; i.e., one which meets the standard's repulpability and recyclability requirements and which is marked accordingly.

Any product that meets this standard can be certified as repulpable/recyclable under the authority of the joint committee.

DRAFT!!

1. Purpose

1.1 This standard establishes a repeatable laboratory method for simulating an appropriate subset of repulping and recycling processes. It is intended for use in evaluating the impact of repulping and recycling treated corrugated fiberboard on mill operations and final products.

1.2 This standard establishes a process for identifying treated corrugated that can be repulped and recycled in this selected subset of systems. It establishes minimum levels of performance for the handsheets made from treated corrugated repulped and recycled in accordance with a detailed test protocol given in Section 5. This standard is not intended to preclude the development or use of any technological advances in mill or treatment processes. It is intended to encourage the repulping and recycling of treated corrugated products.

2. Scope

2.1 This standard applies repulping and recycling process technology readily available to mills involved in recycling.

2.2 This standard establishes a *screening method* for determining the repulpability and recyclability of source separated treated corrugated products that have not previously been considered recyclable. Source separation is specified, so that the concentration of treated product can be controlled. This will allow the mills to determine the acceptable levels of treated product suitable to their specific processes.

2.3 The test method in this standard has 2 parts:
Part 1 determines the repulpability of treated corrugated by determining fiber-on-fiber yield when only the treated corrugated is processed in accordance with this standard. (Appendix A)
Part 2 determines the recyclability of the treated corrugated by evaluating its effect on mill operations and finished products, when added to untreated corrugated. (Appendix B)

2.4 This standard is not intended to address the functionality or marketability of the treated corrugated, or of mill products that use treated corrugated as a fiber source.

2.5 This voluntary standard does not relieve the user from compliance with all applicable local, state and federal laws and regulations and contractual agreements.

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2.6 This standard does not address all of the factors which should be considered in the development of a repulpable treatment. It is the responsibility of companies developing products and testing them under this standard to make sure that, in addition to being repulpable and recyclable, their products will be safe to use for their intended applications, e.g., food contact packaging and that they will not create other non-desirable environmental effects at the point of use or disposal.

2.7 Treated corrugated containers recovered for recycling should not be contaminated by the contents of the boxes, such as hazardous or perishable materials.

3. Definitions of Key Terms

fiber on fiber yield - is the amount of fiber expressed as a percentage of the fiber present in the material to be tested, which remains after the processing action.

handsheets - are sheets made from a suspension of fibers in water in an operation whereby each sheet is formed separately by draining the pulp suspension on a stationary sheet mold.

OCC (Old Corrugated Containers) - is a grade of waste paper comprised of untreated corrugated boxes that have been used for the purpose for which they were originally purchased, and have subsequently been source separated.

recyclable - used paper, including in-plant and post consumer waste paper and paperboard, which is capable of being processed into new paper or paperboard using the process defined in this standard.

repulpable - the test material which can undergo the operation of rewetting and fiberizing for subsequent sheet formation using the process defined in this standard.

source separation - the segregation and collection of individual recyclable components at the point of generation before they become mixed into the solid waste stream.

treated corrugated - is the combined board or boxes which have been subjected to a specific process or product for the purpose of improving the performance of corrugated in the presence of water or water vapor. The level of treatment used in the test must be the same level of treatment as that used in the field.

untreated corrugated - is combined board or boxes which have not been subjected to a specific process or product for the purpose of improving the performance of corrugated in the presence of water or water vapor.

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4. Test Method

Preliminary Analysis: before beginning the test protocol an evaluation of moisture and wax content must be performed.

PART 1: Repulpability

Forty-eight (48) grams of treated corrugated is repulped in a British Disintegrator in artificially hardened water at a pH of 7 (±0.5 pH) that is maintained at 135° F (± 5°) for 75,000 cycles. The pulped material is separated in a screen with 0.010" slots to determine fiber recovery as a percentage of the amount of fiber charged. The amount of coating material deposited on the coupon in the disintegrator is used to measure treatment deposition during repulping. Detailed procedures for repulpability are Appendix A.

PART 2: Recyclability

Mix 10% treated corrugated product and 90% of the same untreated corrugated product in a laboratory-scale pulper at pH 7 (±0.5 pH) and 135° F (± 5°). A charge of 100% untreated corrugated is also pulped using identical conditions as a control. Each pulped material is passed through (in succession) a pressure screen equipped with a basket with 0.062" holes, the same screen equipped with a basket with 0.010" slots and a reverse centrifugal separator under conditions specified in the procedure . Rejects from the treated furnish are analyzed at each stage to determine separation of the treatment from fiber.

Handsheets are made from the final stage (cleaner) accepts with a recirculating white water system, discarding the first six handsheets to affect the proper build-up of materials in the white water. For each furnish the handsheets are pressed and dried with heat and tested for product performance properties. Properties include slide angle (or coefficient of friction), tensile energy absorption (TEA), short span compressive strength (STFI), bursting strength and water drop absorption, using established TAPPI official test methods. The properties and appearance of the handsheets from the treated and untreated furnishes will be compared. Detailed procedures for recyclability are Appendix B.

5. Performance Levels

Treated corrugated products that satisfy all of the requirements of the voluntary standard will be regarded as repulpable and recyclable. There are three performance requirements; fiber yield, operational impact, and product requirements.

Preliminary evaluation of the material to be used as the control should be untreated combined board and must show wax or other extractable content as ≤ 0.5%.

Fiber yield from the repulpability test must be at least 85% based on the fiber charge to the pulper.

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Operational impact is acceptable if 1) the entire procedure can be completed without cleaning the handsheet screens or pressure screen baskets; and 2) there is no measurable deposition of treatment on the coupon and no visible deposition of treatment on any part of the disintegrator.
Product requirements are:

1. Appearance: the appearance of the treated corrugated handsheets must show no substantial difference from handsheets made from the control (untreated furnish).
2. Slide Angle: the decrease in slide angle between the sample means of the handsheets made using treated corrugated product and handsheets made from the untreated material must be no greater than 10%.
3. Strength values: TEA, STFI, burst strength must show no significant decrease from the respective values for the control at the 95% statistical confidence levels for the measurements.
4. Water Drop Penetration: the water drop penetration of handsheets made from treated corrugated product must not exceed the water drop penetration of the control handsheets by more than 200 seconds.

6. Certification/Marking

6.1 Tests for Parts 1 and 2 are repeated twice. If the treated corrugated passes all tests on both trials, it satisfies the standard. If it passes all tests on one trial, but fails some on the other, it may be retested in a third trial. The treated product must pass all tests in the third trial to satisfy the standard.

6.2 Manufacturers of treated corrugated may certify their own product by using any capable laboratory, working in accordance with the detailed protocol provided in this standard. Treated corrugated must be recertified if there is any significant change in treatment product, substrate chemistry or any increase in the level of treatment.

The completed test report from Appendix C must be submitted to AFPA/FBA. Reports will be deidentified for submission to a Standing Committee for use in periodic review of this voluntary standard by the Standing Committee.

6.3 Marking

The repulpable/recyclable certification marking (as shown below) must clearly appear on the box with the assigned AFPA/FBA reference number. The box manufacturer's name must appear on the box in close proximity to the repulpable/recyclable certification mark.

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APPENDIX A REPULPABILITY TEST PROCEDURE

1. Obtain a representative sample of the treated corrugated to be evaluated. Use finished corrugated containers. From this sample, select 50 g of material for test. Selection should be as representative as possible of the material as a whole.

2. Cut selected sample material into approximately 1x1 inch pieces. Determine and record the moisture content [TAPPI T 412] and extractables [TAPPI T 405] and from this determine the amount of oven dry fiber charged.

3. Firmly fix a circular coupon of steel foil to the bottom of the cylinder of a British Disintegrator [TAPPI T 205]. The coupon should be of approximately the same diameter as the disintegrator impeller, rigid enough to withstand the agitation and of known mass and area.

4. Place enough sample to get 24 g of sample material in the disintegrator and add 2L of deionized water. Raise the water hardness to 80-100 ppm with calcium chloride and heat water to 135° F (± 5°).

5. Adjust, if necessary, and maintain the pH at 7 (± 0.5 pH) with dilute acid or base, and repulp for 75,000 revolutions, maintaining 135° F (± 5°) by placing the disintegrator in a water bath or heating mantle held at that temperature.

6. Charge the hot slurry from the disintegrator to a 0.010" slotted opening laboratory vibrating flat screen, preheated to 130 - 135° F. Flush with 2 - 3 gpm of tap water, heated to 135° F (± 5°) for 20 minutes, catching the accepts which pass through the screen in a fine mesh (150 to 200 mesh) screen box.

7. Place the accepts from the screen box into a large beaker or pail, dilute to a known volume with water heated to at least 135° F and determine the consistency [TAPPI T 240] or filter the entire amount through a Buchner funnel, press and dry in the oven so as to accurately determine the mass of accepted solid material. Air dry and determine the moisture content [TAPPI T 412] and extractable content [TAPPI T 405]. Determine the amount of fiber accepted. This amount divided by the amount of fiber charged (step 2.) is the yield of the sample.

8. Repeat steps 4 through 7.

9. Remove the coupon (step 3.) from the disintegrator, wash with a gentle stream of deionized water, air dry and weigh. Determine the deposition of wax and report the weight gain.

10. Throughout the procedure look for depositions on the walls of the vessels and on the screens. Note the presence or absence of deposits in the report.

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APPENDIX B

RECYCLABILITY TEST PROCEDURE

Note: Pulp should never be allowed to exceed 140° F.

1. Obtain a sample representative of the treated corrugated to be evaluated. Use finished corrugated containers. From this sample select 10 lbs of material for test. Selection should be as representative as possible of the material as a whole. Also necessary will be 90 lbs of untreated corrugated board from the same base material that has been treated.

2. Cut selected sample materials into approximately 7x15 inch pieces with a suitable apparatus (i.e. power band saw). Determine the moisture content [TAPPI T 412] and extractable content [TAPPI T 405] of the treated and untreated samples.

3. Selection of the charge will depend upon the capacity of the laboratory pulper to be used. Pulping is to be carried out at 3% consistency. The charge will consist of 10% (by weight) of the material to be tested and 90% of the untreated corrugated board. Calculate the percentage of wax charged, based on oven dry fiber weight in the charge. Bring the equipment above 135° F. Adjust the pH of the charge so that after pulping the pH will be equal to 7 (± 0.5 pH). Charge the pulper and raise the temperature to 135° (± 5°)F. Pulp for 15 minutes while maintaining 135° (± 5°)F.

4. Repeat step 3 until sufficient material has been obtained for the following steps. Maintain the temperature of stock at 135° (± 5°)F until it is used in step 5.

[Note: If the test must be halted to clean apparatus in either of the 2 screening steps or the handsheet making step, discontinue the procedure and report the test as a failure.]

5. Combine the pulp from the several batches and dilute to 1% consistency with water heated to 135° (± 5°)F. Adjust the pH to 7 (± 0.5 pH). Preheat a screen with 0.0625" holes to about 135° F, maintaining the temperature through the preheated screen at a volumetric reject rate of 10% of the feed rate.

6. With the accepts from step 5 repeat the procedure in step 5, using a screen with basket with 0.010" slots, again maintaining the temperature, consistency and a 10% reject rate.

7. Recirculate the accepts from step 6 through a reverse centrifugal-type cleaner, maintaining the temperature and consistency at the pressure differential specified for the cleaners being used. Determine the volumetric reject rate and report.

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8. From the accepts from step 7 form handsheets according to TAPPI T 205 with the following conditions:

   The slurry should be maintained at 135° F (± 5°) pH of 7 (±0.5 pH).
   Form and discard six standard (1.2 g) handsheets, recirculating the water, accept the seventh and succeeding handsheets until the number required for the tests has been made.

   Dry under restraint to 7% moisture content on a surface dryer maintained at 250° F - 275° F.

   Test the handsheets [TAPPI T 220] for:

   Basis Weight, Caliper, Apparent Density
   Slide Angle or Coefficient of Friction [TAPPI T 815 or 816]
   Tensile Energy Absorption, (TEA) [TAPPI T 494]
   Short Span Compression (STFI) [TAPPI T 826]
   Bursting Strength
   Water Drop Penetration (TAPPI T 819)

   using the procedures referenced in TAPPI T 220 where not specifically designated above.

9. Calculate on a sheet-by-sheet basis, the index of each of the strength tests (Burst, etc.) i.e. test result ÷ basis weight. Report these results, the volumetric reject rate used in step 7, any observations of deposition in any stage of the process, the appearance of the handsheets and any deviations from this procedure.

10. Report using provided form.

APPENDIX C

Completed by submitter

TEST REPORT, MATERIAL SUBMISSION INFO

Submitted Info:

- Company Name _____
- DBA (if applicable) _____
- Division (if applicable) _____
- Product Mgt: _____
  - Contact Name: _____
    - Position: _____
    - Address: _____
    - Phone: _____
    - Fax: _____
    - E-mail: _____

Treatment/Product Info:

- Product Name: _____
- Treatment Type, i.e., emulsion (aqueous), modified wax, solvent-based coating, other: _____
- Intended Application Method, i.e., cascaded, dip, surface coated, impregnated, other: _____
  (if more than one method is proposed multiple submissions or "toughest" case must be submitted)
- Intended treatment weight (per 1000 ft. sq. of combined board). _____ lbs.

Affirmation *To be signed by a person who is an officer of the above company and authorized to represent/bind the above company.*

- All materials and information submitted to the lab and FBA for the purposes of testing and certification of the above product are accurate as represented above.
- Appropriate company personnel have thoroughly read and understand the voluntary standard so as to prepare and submit materials and information correctly.
- Materials and containers represented (by this company or licensee) as certified to the voluntary standard meet and will continue to meet sections 6.2 and 6.3 of the standard [as they are manufactured, tendered for commerce and enter the recycling stream].

Signed: _____ Date: ___/___/___

Name: _____

Title: _____

SUBSTRATE, TREATMENT DETAILS

Note: - Substrates (control and treated) must be from same run (i.e., identical)

1.

	COMPONENT	BASIS WT.	CONTAINERBOARD TYPE (i.e., KLB, SCB, RLB.)	MILL SOURCE	WET STRENGTH? HARD-SIZED? DETAILS:	"NON-SUBJECT" TREATMENTS? DETAILS:	COLOR COATED? DETAILS:	SUBJECT TREATED? Y/N? METHOD, i.e., CASEMFG. COAT/ IMPREG., etc.	NOTES
SINGLEWALL	OUTSIDE LINER								
	MEDIUM								
	INSIDE OR CENTER LINER								
*DOUBLEWALL	*MEDIUM								
	*LINER								

2. Describe intended treatment method(s).

3. Describe how this treated board (submitted sample) was treated.

Completed by: _____

Date: _____

Page 2
Completed by submitter

TEST REPORT: Repulpability Process (part 1) Completed by lab

Note: To be completed by Lab Manager actively involved in the test process.

Trial No.: _____ Date Run: ___/___/___

	Set #1:	Set #2:
1. Is sampling representative of the material as a whole?	Y/N	Y/N
2. Moisture Content	____%	____%
3. Extractables Content	____	____
Steel Foil Coupon (starting)		
Mass (g)	____	____
Area (___/sq)	____	____
4. Water Hardness (ppm)	____	____
Temperature Range (°F)	____	____
Amt. of Fibre in Charge (g)	____	____
6. Temp/pH Maintained (?)	Y/N	Y/N
8. Hot Slurry Charged To Flat Screen, as Instructed (?)	Y/N	Y/N
7. Accepts Consistency	____	____
(or) Oven Dry Mass	____	____
• Moisture Content	____	____
• Extractables Content	____	____
• Amount of Fibre Accepted	____	____
• Yield of Sample	____	____
9. Steel Foil Coupon (final)		
Mass (g)	X	____
? Measurable/Statistically Significant?	Y/N	Y/N
10. Observe and Note Deposition(s) on Vessel Walls, Screens, Moving Parts, etc.: Deposition Observed?	Y/N	Y/N
If yes, explain in detail on attached sheet		

SUMMARY Operational Impact: pass/fail pass/fail

Yield: pass/fail pass/fail

Notes/Explanations:

_____

_____

_____

_____

Page 4
Completed by lab

TEST REPORT: Recyclability Process (part 2)

Trial No.: _____ Date Run: __/__/__

	Treated:	Control:
1. Is sampling representative of the lot as a whole?	Y/N	Y/N
2. - Moisture Content:	_____	_____
- Extractables (Quantify):	_____	_____
- *Less than 0.5% (?)		Y/N
- Control and Treated Substrates Appear Identical?		Y/N
3. Pulping at 3% Consistency?	Y/N	Y/N
- 10/90% Charge by Bulk Wt.?	Y/N	
- Temp/pH Conditions Maintained (per App. B, #3)	Y/N	Y/N
- No. of Batches Req'd to Achieve 100 lb. Total:	_____	_____
5. .0625 Screens		
1% Consis., Temp, pH (per App. B, #5)?	Y/N	Y/N
10% Volumetric Reject Rate?	Y/N	Y/N
6. .010 Basket:		
Temp, pH, Reject Rate (per App B, #6)?	Y/N	Y/N
7. Reverse Cleaners:		
Temp, Press. Differential (per App B, #7)?	Y/N	Y/N
Determine Volumetric Reject Rate?	_____	_____
8. Has the test been halted to clean any apparatus anytime in this procedure?	Y/N	Y/N
Thoroughly observe for deposition(s) on walls of vessels, screens and moving parts. Depositions observed?	Y/N	Y/N
*If yes, detail below.		
9. Was the pulp/slurry ever subjected to temperatures above 140°F?	Y/N	Y/N

Notes, details:

_____

_____

_____

_____

_____

Page 5
Completed by lab

TEST REPORT: Handsheet Formation and Product Performance

Trial No.: _____ Date Run: ___/___/___

- HANDSHEET FORMATION PROCESS: TAPPI T-205 followed with recirculating whitewater system, temp & pH maintained, handsheets 1-6 discarded, dried to 7% moisture content under restraint @ 250-275°F, (per App. B, #8).
  Yes/No

- Product Performance Treated Control

1. Slide Angle (Static C.O.F.) T-815 OM96

Handsheet #	Test Data	Handsheet #	Test Data

$\bar{x}$ = _____ ° $\bar{x}$ = _____ °

- Decrease in slide angle (if any) of treated material versus control: _____ [control $\bar{x}$ - treated $\bar{x}$]

2. Water-Drop Penetration T-831 OM93

Handsheet #	Test Data	Handsheet #	Test Data

$\bar{x}$ = _____ sec. $\bar{x}$ = _____ sec.

- Increase in water-drop penetration time formatted vs. control: _____ [treated $\bar{x}$ - control $\bar{x}$]

TEST REPORT: Product Performance (continued)

Trial No.: _____ Date Run: __/__/__

Treated Control

3. Tensile Energy Absorption (T.E.A.) T-494 OM88

Handsheet #	Basis Wt.	Test Data	Indexed Data	Handsheet #	Basis Wt.	Test Data	Indexed Data

$\bar{x}$ = _____ _____ _____ $\bar{x}$ = _____ _____ _____

- Is the decrease (if any) in T.E.A. of treated versus control significant at a 95% statistical confidence level?

Yes / No / _____ Initials

Notes, details:

_____

_____

_____

4. Short Span Compression (STFI) T-826 pm 92

Handsheet #	Basis Wt.	Test Data	Indexed Data	Handsheet #	Basis Wt.	Test Data	Indexed Data

$\bar{x}$ = _____ _____ _____ $\bar{x}$ = _____ _____ _____

- Is the decrease (if any) in "short span/STFI" of treated material versus control significant at a 95% statistical confidence level?

Yes / No / _____ Initials

Notes, details:

_____

_____

_____

TEST REPORT: Product Performance (continued)

Trial No.: _____ Date Run: ___/___/___

5. Burst Strength T-403 OM91

	Treated				Control		
Handsheet #	Basis Wt.	Test Data	Indexed Data	Handsheet #	Basis Wt.	Test Data	Indexed Data
$\bar{x}$ =				$\bar{x}$ =			

- Is the decrease (if any) in burst of treated material versus control significant at a 95% statistical confidence level?

PASS / FAIL SUMMARY

	Trial #1	Trial #2	Trial #3
1. Treated and controls: Substrate, samples, specimens appropriate (Y/N)			
2. Fibre Yield ≥ 85% - per section #5, etc. (Y/N)?			
3. Operational Impact Acceptable? - per section #5, etc. (Y/N)?			
4. Product Performance Acceptable? - per section #6, etc. (Y/N)?			
Overall Pass / Fail - by trial: - per section #8, et al			

MATERIAL AS SUBMITTED "PASSES"
VOLUNTARY STANDARD - DATED ___/___/___
(Write pass or fail): _____

Signed: _____ ___/___/___

Name: _____

TEST REPORT (continued)

Affirmation:

- This labs facilities and equipment are capable of testing the tendered product within the instructions and tolerances of the current voluntary standard.
- Personnel running and reporting these tests are competent and trained to accurately do so. They have followed the letter and spirit of the subject voluntary standard.
- Objective and subjective information, as contained herein, is accurate.

Signed: _____ Lab Manager

_____ Name

_____ Title

___/___/___ Date

Instructions - If material "passes":

Lab manager: Make two (2) photocopies of entire report, each bearing an original signature on page 8 (above).
- Provide 1 copy to submitting company.
- Retain 1 copy indefinitely.
- Provide for retention:
  1 set each (to: company, lab, FBA):
  2 - 12" x 12" control material
  2 - 12" x 12" treated material
  3 - representative handsheets
- Provide original, signed report to Fibre Box Association with 1 set of above materials.

Submitting Company: When the above "passing" test report and materials is received by the FBA you will promptly receive a "Reference Number" unique to this material and test results. This is your authority to imprint/certify packaging made appropriately with this treatment as meeting this voluntary standard.