INSTITUTE OF PAPER CHEMISTRY
Appleton · Wisconsin

SUMMARY OF REPLIES TO QUESTIONNAIRE REGARDING THE PERFORMANCE OF SACKS AND SACK PAPER

Project 2033

Progress Report Three

to

MULTIWALL SHIPPING SACK PAPER MANUFACTURERS

November 1, 1958

THE INSTITUTE OF PAPER CHEMISTRY

Appleton, Wisconsin

Project 2033

SUMMARY OF REPLIES TO QUESTIONNAIRE REGARDING THE PERFORMANCE OF SACKS AND SACK PAPER

Progress Report Three

to

MULTIWALL SHIPPING SACK PAPER MANUFACTURERS

November 1, 1958

TABLE OF CONTENTS

THE INSTITUTE OF PAPER CHEMISTRY

Appleton, Wisconsin

INTRODUCTION

This report summarizes information regarding the performance of sacks and sack paper obtained by means of a questionnaire which was distributed to the companies which are members of the co-operative research group known as "Multiwall Shipping Sack Paper Manufacturers." The various items on which information was requested are tabulated for each mill in this report in the same order that they appeared in the questionnaire. For instance, data on sack paper tests are shown in Table I; data on sack drop tests are presented in Table II; information relative to sack performance is summarized in Table III; and dimensional information is given in Table IV. It will be noted in Table I that Section 4 from Part I of the questionnaire has been eliminated because very little information on this subject was obtained. It is anticipated that this subject (normal quality level and rejection level) will be given more comprehensive treatment in the near future.

TABLE I

SUMMARY OF REPLIES TO QUESTIONNAIRE REGARDING THE PERFORMANCE OF SACKS AND SACK PAPER

Part I: Sack Paper Tests

		Mill Code A	B	C	D	E	F
1. Tests regularly performed at reel and/or after conditioning		1. Basis weight	Basis weight	Basis weight	Basis weight	Tear	Tensile
		2. Tear	Tear	Tear	Tear	Tensile	Tear
		3. Tensile	Tensile	Tensile	Tensile	Basis weight	Basis weight
		4. Stretch	Moisture	Stretch	Moisture	Moisture	Moisture
		5. Porosity	Mullen	Porosity	Mullen	Sizing	Size
		6. Sizing	Porosity	Ink penetration	Size	Caliper	Porosity
		7. Moisture	Caliper	Moisture	Caliper	Porosity	Caliper
		8.	Size		Stretch	Mullen	Smoothness[a]
2. Arrangement of tests in order of decreasing importance		1. Basis weight	Basis weight	Tear	Basis weight	Tear	Tensile
		2. C.D. tensile	Tear	Tensile	Tear	Tensile	Tear
		3. Moisture	Tensile	Basis weight	Tensile	Basis weight	Basis weight
		4. M.D. tear	Moisture	Moisture	Moisture	Moisture	Moisture
		5. Stretch	Mullen	Ink penetration	Mullen	Sizing	Size
		6.	Porosity	Porosity	Size	Caliper	Porosity
		7.	Caliper	Stretch	Caliper	Porosity	Caliper
		8.	Size		Stretch	Mullen	Smoothness
3. Make and model tester used in above	Tensile	American Testing Machines (T.-A.)	T.M.I.	Schopper, T.A. Hydraulic, Instron	Amthor 254	T.A. 37-4	T.M.I.-pendulum
	Tear	Elmendorf (old type)	Elmendorf	Elmendorf (old)	Elmendorf	Elmendorf	Elmendorf
	Basis weight		Toledo scale	T.M.I.	Thwing-882		Toledo 9212
	Moisture		Hart K103 and gravimetric	Hart and gravimetric	Gravimetric & Mois.Reg.K-2-D	Hart K-105	Gravimetric
	Mullen		B.F.Perkins		Perkins Model C	Perkins	
	Porosity		Gurley	Gurley-Hill	Gurley Model 4110	Gurley	Gurley-100 cc.
	Caliper		Cady		Cady	Schopper T.M.I.	Cady (auto.)
	Size		Currier	Ink flotation	Dry Ind. TAPPI		Sugar dye
	Miscellaneous						Smoothness: Sheffield

[a] Rough finish sack paper.

TABLE I—Continued

SUMMARY OF REPLIES TO QUESTIONNAIRE REGARDING THE PERFORMANCE OF SACKS AND SACK PAPER

Part I: Sack Paper Tests

		Mill Code G	H	I	J	K	L
1. Tests regularly performed at reel and/or after conditioning		1. Basis weight	Caliper	Tensile	Note b	Basis weight	Basis weight
		2. Tear, M.D.	Basis weight	Tear		Caliper	Tear
		3. Tear, C.D.	Mullen	Moisture		Tear	Tensile
		4. Tensile, M.D.	Tear	Basis weight		Bursting strength	Moisture
		5. Tensile, C.D.	Tensile	Sizing		Tensile-Stretch	Porosity
		6. Sugar size	Porosity	Stretch		Porosity	Penetration (Stockig sizing test)
		7. Porosity	Sizing	Profile (basis wt.)		Size	Mullen
		8. Moisture	Moisture	Caliper		Moisture	
		9.		Porosity		Stiffness	
		10.		Mullen			
2. Arrangement of tests in order of decreasing importance		1. Moisture	Tear	Tensile		Tensile	Basis wt.)
		2. Tensile, C.D.	Tensile	Tear		Stretch	Tear) Equal
		3. Tensile, combined	Mullen	Moisture		Tear	Tensile) importance
		4. Tear, M.D.	Moisture	Basis weight		Moisture	
		5. Tear, combined	Porosity	Sizing			
		6. Basis weight	Sizing	Stretch			
		7. Porosity	Basis weight[a]	Profile (basis wt.)			
		8. Sugar size		Caliper			
		9.		Porosity			
		10.		Mullen			
3. Make and model tester used in above	Tensile	T.M.I.-pendulum	Electra-hydraulic, Thwing-Albert Model 38-4	Amthor Model 1028 (stretch attachment)		Thwing-Albert Model 49C	Amthor type 254 Model P
	Tear	Elmendorf	Elmendorf, T.A. Cat. No. 60-100	Elmendorf		Thwing-Albert Elmendorf	Std. Thwing-Albert Elmendorf
	Basis weight	Toledo 9212		Profile: Foxboro Beta-Ray Req.: Toledo 9210		Cady Scales	Toledo Model 9210, 9210AQ
	Moisture			Gravimetric		Gravimetric (Williams Moisture Testing Oven)	
	Mullen		Perkins Model 6	Model C		Perkins	Perkins Model C
	Porosity	Gurley 4110 and 4100	Gurley Densometer	Gurley Densometer		Gurley Densometer	Gurley SPS
	Caliper			Cady (D.W.-374)		Cady	
	Size	TAPPI		Ink Flotation		Sugar dye	
	Miscellaneous					Stiffness: Gurley R.D.	

[a] Very important from yardage standpoint.

[b] No data because of very limited experience manufacturing multiwall sacks. Govt. spec. UU-S-486 is followed, both at the machine and rechecking in the laboratory under standard conditions. Rolls not meeting these specifications are rejected.

TABLE I—Continued

SUMMARY OF REPLIES TO QUESTIONNAIRE REGARDING THE PERFORMANCE OF SACKS AND SACK PAPER

Part I: Sack Paper Tests

	Mill Code A	B	C	D	E	F
5. Tests used occasionally	None	Wet strength smoothness (Gurley)	M.I.T.Fold[b] Gurley stiffness[c] Gurley smoothness[d] Slide angle[d] Mod. Gurley smoothness[d]	Porosity[e] Stretch[f] Ink flotation[g]	None	Bursting strength Fold Stretch pH Brightness Dirt count
6. Tests tried in addition to (1) or (5) above	None	Impact-fatigue test (Steel balls)	Work Mod. of Elast. Fatigue—Instron Korput dyn. tensile Frag dyn. rupture	None	None	Stiffness S and S Scuff Coefficient of friction
7. Reports relating to sack properties	Yes[a]	Suggest Fed. Spec. UU-S-48b	Yes	None	None	Yes[a]

[a] Confidential.
[b] To study aging of paper.
[c] Stiffness of paper.
[d] Check rough finish and anti-slip coatings.
[e] Some measure of formation and paste penetration.
[f] Formerly in Government Spec.; influence on impact failure.
[g] Measure of sizing: 3 min. flotation Scheaffer's script Permanent Blue-Black No. 232. Blot between towels and examine visually.

TABLE I—Continued

SUMMARY OF REPLIES TO QUESTIONNAIRE REGARDING THE PERFORMANCE OF SACKS AND SACK PAPER

Part I: Sack Paper Tests

	Mill Code G	H	I	J	K	L
5. Tests used occasionally	Stretch, M.D. and C.D. SPS Smoothness	None	Note a		None	Note b
6. Tests tried in addition to (1) or (5) above	Smoothness (Williams)	None	Folding endurance, stiffness, moisture absorption, and pick tests.		None	Note c
7. Reports relating to sack properties	None	None	None		None	None

[a] Impact (Van der Korput tensile tester): Attempt to correlate tensile and stretch tests with drop tests by measuring work capacity or rupture energy.
Skid resistance (variable inclined plane): To measure resistance to skid, particularly of anti-skid treated sack paper.
Smoothness (smoothness tester, TAPPI Routine Control Method RC-36): To evaluate the finish of sack paper in terms of lateral porosity.
Acidity or alkalinity: To meet government specifications for noncorrosive paper (Method described in paragraph 4.2.4 of Mil-B-130A).
pH (Method 200 of Fed. Spec. UU-P-31B): Test for noncorrosive paper.

[b] Stress-strain diagrams of papers involved in complaints and comparative tests of competitive papers. Areas under the curves are compared. Tester used: Thwing-Albert Model 35-4.

[c] An impact tester has been made from a discarded tear tester that measures the work done in breaking a one-inch strip of paper. This appears promising but a new instrument must be built.

TABLE II

SUMMARY OF REPLIES TO QUESTIONNAIRE REGARDING THE PERFORMANCE OF SACKS AND SACK PAPER (Continued)
Part II: Sack Drop Tests

	Mill Code A	B	C	D	E	F	G	H	I	J	K	L
1. Are drop tests performed as quality index? What specifications are enforced?	Yes None	No	No	No sack data	No sack data	No sack data	Yes Note c	No sack data	No None	No sack data	No None	No sack data
2. Drop test procedure preference[a]:	Pasted / Sewn	Pasted / Sewn	Pasted / Sewn				Pasted / Sewn		Pasted / Sewn		Pasted / Sewn	
Flat drop--constant height	3 / 3	1 / 1	3 / 3								1-48" / 1-48"	
Flat drop--progressive height	1 / 1	4 / 4	1 / 1				1[d] / 1[d]		1 / 1			
Butt drop--constant height	4 / 4	3 / 3	2-18" / 2-18"				2[d] / 2[d]				2-18" / 2-18"	
Butt drop--progressive height	2 / 2	5 / 5										
Gusset drop--constant height	5 / 5	2 / 2	Special / Special				3[d] / 3[d]					
Others	Note b	— / —										
3. Are reports explaining test procedure preference available?	No	No	No				Yes		None available		No	
4. What commodity is used as a "standard" fill?	Cement	Commodity to be packaged.	Cement & commodity to be packaged.				Product to be packaged.		Sand		Use material with which each is to be filled when possible, otherwise cement.	
5. What specifications are to be used to define standard fill?	94 lb./ft.^{3}	None	—				Commercial quality		None		None	
6. Is commodity reused from bag to bag during testing?	Yes	Yes	Powdery products used for period and discard. Granular used once or screened to maintain particle size.				Yes		Yes		Yes	
7. What precautions are taken to minimize the effect of changes in commodity?	None	Visual checks	Test one specimen from each sample in rotation.				Check density every 100 bags.		Use fresh sand when old supply becomes radically changed in physical properties.		Generally used only for one series of tests, then replaced.	
8. Is sack turned over after each fall? Is sack turned end-for-end after each fall?	Yes No	Yes No	Yes No				Yes No[e]		Yes No		Yes No	
9. Are tests performed in conditioned atmosphere?	Yes	Yes	Yes				Yes		Attempt to control		No	
Preconditioning data:	2 hr. at 73±2°F., 50 ± 2% R.H.	73°F-50% R.H.	100°F.				None		70°F., 50% R.H.		—	
Conditioning data:	2 hr. at 73±2°F., 50 ± 2% R.H.	73°F.-50% R.H.	73°F.-50% R.H.				48 hr. at 73°F., 50% R.H.		73°±3.5°F., 50% ±2% R.H.		—	

[a] Figures indicate relative order of preference.
[b] The progressive drop test is not necessarily favored at the present and was only resorted to as a means of dropping sacks in the last three years. We are presently leaning towards returning to the constant-height drop test.
[c] Standards based on past experience which we use to observe trends and take appropriate action.
[d] Preference ratings are tentative as preference depends on reason tests are made. Each particular test is designed to tell something different about the bag.
[e] Alternate bags are turned end-for-end.

TABLE II--Continued

SUMMARY OF REPLIES TO QUESTIONNAIRE REGARDING THE PERFORMANCE OF SACKS AND SACK PAPER (Continued)
Part II: Sack Drop Tests

	Mill Code A	B	C	D	E	F	G	H	I	J	K	L
10. Specifications on conditioning time for filled sacks and fill:	None[a]	24 hr.	Filled bags 15-30 min.	No sack data	No sack data	No sack data	None--Tested immediately after filling	No sack data	None	No sack data	None	No sack data
11. Is split table used for drop tests?	Yes	Yes	Yes for flat drop. Clamp end of bag for butt drop--18".				Yes		Yes		Yes	
12. Type of unlatching mechanism:	Chain eye & trip arm[b]	Automatic or trip	Mechanical lever arm release on old tester and solenoid release on new tester.				Solenoid activated latch.		Solenoid controlled spring release.		Lever actuated latch	
13. Has reproducibility of tester been studied?	No	No	Flatness of drop studied with high-speed camera.				Yes--results indicate test weight reproducible.		No		No	
14. Are reports on reproducibility available?	No	No	Of uncertain value.				Not available		No		No	
15. Type of base:	Concrete[c]	12" concrete supported by ground.	Note d.				Note e.		Concrete overlaid with steel plate. Concrete base is 18" thick supported on concrete floor of room.		Concrete (Six-inch concrete on gravel base on ground).	
16. Type medium used on base to facilitate handling the sack:	None	Sheet of paper	Canvas (6 oz.)				1 sheet 42-lb. board.		Sheet of 70-lb. wet strength kraft reinforced with strips of masking tape.		None	
17. Has rigidity of base been determined?	No	No	No				No		No		No	
18. Are there appended to the questionnaire a copy of drop test procedure and a photograph of drop test apparatus?	Partial	Partial	Partial				Yes		Yes		No	

[a] Cement storage and valve packer contained in constant humidity room where bags are filled and drop tested.
[b] Mechanical--large "chain-eye" hooked over a trip arm, which can be released either by manual pull or a pre-set finger trip.
[c] Reinforced concrete floor slab with supporting I-beam directly beneath drop tester impact point.
[d] Old flat drop, 10-inch concrete; butt drop, 1/2" sheet metal; new flat drop, 10-inch concrete backed by 30x30x30-inch concrete block.
[e] Concrete. Bags drop onto concrete pad 4x4x3 feet thick supported by reinforced concrete and steel pipe column standing on a concrete base approximately 6x6x3 feet thick, approximately 5 feet under ground level resting on packed earth.

TABLE III

SUMMARY OF REPLIES TO QUESTIONNAIRE REGARDING THE PERFORMANCE OF SACKS AND SACK PAPER(Continued)
Part III: Sack Performance Data

	Mill Code											
	A	B	C	D	E	F	G	H	I	J	K	L
1. Are studies available defining?				No sack data	No sack data	No sack data		No sack data		No sack data		No data [a]
a. Location of failure	No	Not available	Yes				Yes		No		No	
b. Cause of failure	No	Not available	Yes				Yes		No		No	
c. Frequency of failure	No	Not available	No				Yes		No		No	
2. Are data available defining relative performance of												
a. Sewn and pasted valve sacks	No [b]	No	Yes				Yes		No		No	
b. Effect of number of plies and their weight	No	No	Yes				Yes		No		No	
3. Are field and laboratory data pertaining to the effect of commodity in sack performance available?	No	No	No				Yes		No		No	
4. Has any attempt been made to measure the nature, magnitude and distribution of stresses and strains in a sack?	No	No	Yes				No		No		No	
5. Procedure used in 4 above	--	--	Photographic technique tried unsuccessfully				--		--		--	
6. Have you been able to relate paper properties to sack performance? (Append reports).	Yes	None	Yes (Qualified)				None		Indications are that a higher CMD stretch improves sack performance.		None	

[a] Poor sack performance almost invariably is found to be attributable to one of the following:
(1) Snagging or other mishandling by user.
(2) "Dry" bags resulting from bad bag storage conditions or filling with hot material.
(3) Malmanufacture of bags that somehow got by the bag inspectors, such as poor nesting of the plies, plies stuck together by faulty seam-gluing, etc.

[b] Do not have definite field test data. However, we can comment that with the history of making millions of sacks of both types and by studying complaint records, we can not show that one type of sack outperforms the other. The same comment holds true for laboratory tests.

TABLE IV

SUMMARY OF REPLIES TO QUESTIONNAIRE REGARDING THE PERFORMANCE OF SACKS AND SACK PAPER (Continued)
Part IV: Dimensional Data

	Mill Code A	B	C	D	E	F	G	H	I	J	K	L
1. How do you measure sizes of sacks?	Face Gusset Over-all length	Length, width, gusset, inches	Note a.	No sack data	No sack data	No sack data	Note b.	No sack data	Over-all length Over-all width Gusset width	No sack data	Procedure appended (Pictorial)	—
2. How do you determine the degree of nesting of the plies?	Note c.	Stretch sack out; see that all plies are uniform.	Note d.				Measure at corner of tube.		Visual observation only.		Cutting strips and either measuring or extending to break.	Note e.
3. Influence of dimensional changes on performance	No data	Only when sack is too small.	Note f.				Note g.		No definite data.		Usually length should be about twice width. Minor variations do not seem too important.	Non-uniform change will result in poor nesting.
4. Factors Associated with each of the following governing dimensional stability:												
a. Base paper	No comment	--	See note f. Nesting can be affected by moisture conditions.				Stretch, moisture		Unknown		Moisture, stretch, loose edges.	Uniformity of moisture content.
b. Conversion operation	Note h.	--	Misadjustment on the forming table can affect nesting.				Unknown		Unknown		Friction on rolls; snugness to former.	Not significant as all plies are affected uniformly.
c. Design	Normally best where L = 2 W	--	Note i.				Unknown		Unknown		Number of plies, basis weight & width of bag.	Unknown
d. Environmental	Note j	--	See 4-a above				Unknown		Unknown		Storage and converting conditions.	Unknown

TABLE IV—Continued

SUMMARY OF REPLIES TO QUESTIONNAIRE REGARDING THE PERFORMANCE OF SACKS AND SACK PAPER (Continued)
Part IV: Dimensional Data

Notes:

[a] We determine the size of sacks by measuring the tube length before ending, the finished bag length, the face width, gusset width, top and bottom width (pasted bags). All dimensions are outside measurements. The valve size is determined by the maximum length of the free space when the bag is in the flattened condition.

[b] SV: Measure end to end at center. For perimeter pull out the gussets and measure across the flattened gusset and the face at center and multiply by 2.

[c] Normally by the "hand stretch" method, although in those cases where this is of primary importance, a German-made tensile tester is used. A continuous circumferential strip is cut from the bag and looped over two rollers that can be retracted and show up whether a ply is loose or not.

[d] We determine the degree of nesting of the plies as follows:
A 1-inch annular ring is cut around the bag, stapled at the glue seam, cut at that area, and suspended by the stapled end. One hundred-gram weights are hung by bulldog clips from the free end of each ply. All plies are combined near the free end and stapled together. The weights are then removed and measurements made in 16ths of an inch comparing the length of projection of plies relative to the end of the inside ply. We expect in 36 to 40-inch circumference tubes that each succeeding ply from the inside will be 1/16th inch longer. This is reported as 0 (inside), +1, +2, +3, +4 (in a perfectly nested five-ply) bag. If all plies but number 3 are perfectly nested and number 3 is too tight, then a reading of 0, +1, +0, +3, +4, or even 0, +1, -1, +3, +4 would indicate this fact. A loose outside ply might be 0, +1, +2, +3, +7.

[e] Degree of nesting of plies is determined routinely by visually examining the nesting of the loops obtained when two cuts are made across the sack at one-inch spacing. For more careful work, the nested loops are pulled between rings on a recording tensile tester with the "dog" raised. The maximum value is expressed as a percentage of the sum of the ply strengths tested individually.

[f] Effect of dimensional changes on bag capacity can be related to bag performance. In materials where a light bag is usually the case or where, such as clay, bag flatteners are used, bag size is critical. A cement bag manufactured at 78% R.H. and subsequently subjected to 14% R.H. will lose as much as 3% (34 cubic inches) in volume caused by the contraction of the paper. Much of the cold, dry weather breakage in valve bags may be caused by smaller bag capacities as well as the usual loss of physical strength in the paper.

[g] Wide (5" or greater) bottoms on PV bags and wide (5" or greater) gussets on SV bags tend to lower drop test performance.

[h] With some products—especially granular free-flowing products like sugar and salt—a slight size change in the bag can prove to be detrimental to sack performance. For products such as starch and flour, small size changes do not noticeably affect sack performance.

[i] Special sheets such as plastic coated, asphalt laminated, wax laminated or impregnated, have different hygroexpansivity and/or rates of change of dimensions which in turn affect the nesting and performance of the bag. The barrier sheet should be as close to the contents as practicable so that as many natural kraft plies as possible will be subjected to the same conditions.

[j] This can be one of the most important factors in the governing of dimensional stability of a sack. The conditions under which bags are stored, prior to being filled, have a great deal to do with the performance of the sack. Many companies precondition a day's run of sacks 24 hours or so before they are placed on the packer.

THE INSTITUTE OF PAPER CHEMISTRY

W. Hubert

W. N. Hubert, Research Aide

RCMcKee

R. C. McKee, Chief, Container Section

IPST HASELTON LIBRARY
5 0602 01062001 3