

THE INSTITUTE OF PAPER CHEMISTRY, APPLETON, WISCONSIN

Report Seven

Monthly Progress Report

to

U. S. ARMY CHEMICAL CENTER PROCUREMENT AGENCY

✓ Project 2256

Report Period: March 29, 1961 to April 28, 1961

May 24, 1961

THE INSTITUTE OF PAPER CHEMISTRY

Appleton, Wisconsin

DEVELOPMENT OF AN IMPROVED DIFFUSION BOARD MATERIAL

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THE INSTITUTE OF PAPER CHEMISTRY

Appleton, Wisconsin

DEVELOPMENT OF AN IMPROVED DIFFUSION BOARD MATERIAL

SUMMARY

Four samples of pulp have been received from Wood Conversion Company, representative of their no. 3 machine stock and the three individual components of it. Boards have been made to determine the relative effects of the individual pulps on density and other board characteristics. Samples of willow and pine pulps have been received from Armstrong Cork Company but have not yet been evaluated.

Three sizing materials have been evaluated on a Wood Conversion Company pulp blend. These three (Aquapel 486, Aquapel 360, and Cyron) were added in varying amounts, with different orders of addition and subjected to extra drying. Sizing was evaluated by the two-hour water-immersion test and values as low as 5 to 6% by volume were attained. Gas life evaluations were started and preliminary results indicate that excessive amounts of sizing will hurt the CK life.

Gas life evaluations were received on sizing trials made on the M & O pulps, and indicated detrimental effect of excessive drying and some effect of the sizing agents on gas life. The work with this pulp had been discontinued because of doubt that the only available pulp (containing some rosin size and alum) would be representative of what would be used in commercial trials using alkaline sizes.

Trials of planing boards to improve control of thickness indicated some effect on gas life not proportional to thickness and additional investigation was initiated.

TABLE I
WOOD CONVERSION COMPANY PULPS

Sample	pH of Hot Water ^a Extract	pH of Cold Water ^a Extract	Ash, ^b %	Canadian Freeness, cc.
10-853	5.7	6.0	1.17	752
10-854	5.2	5.6	0.79	797
10-855	5.7	6.2	1.26	731
10-890				755

^aTAPPI Standard T 435 m-42.

^bAsh-ignited at 750°C. for 1.5 hr. reported on ovendry basis.

Boards were formed from the samples under varied wet-pressing conditions for evaluation of their density characteristics. Based on ovendry fiber, 25% charcoal was incorporated into each board (see Table II). From this data it was determined that a 21 lb./cu. ft. board could be produced from a mixture of 52.2% 10-855 pulp and 47.8% 10-853 pulp. The 10-854 pulp was found to be too free and not dense enough to be useful to any extent in a diffusion board.

The pulp sample labeled 10-890 was not received until after work had begun using the other three pulps; consequently, no laboratory data as to sizeability or gas life is presently available. However, data on the relationship of the density of this pulp to the degree of wet pressing indicate that a mixture of 17% 10-855 and 83% 10-890, pressed 10 minutes at 150 p.s.i., should be used to produce a 21 lb./cu. ft. diffusion board.

PULPS FROM ARMSTRONG CORK COMPANY

Two 250-lb. drums of pulp, one of willow and one of pine, were received from the Armstrong Cork Company. At the end of this reporting period, no work had been done with these pulps.

SIZING

The selection of sizing materials and retention aids comprise the two primary variables requiring evaluation by water absorption, gas life, carbon dioxide diffusivity, and strength tests. The amounts of these materials necessary for effective sizing and tolerable in terms of the function of diffusion board must be considered, and considered concurrently, in evaluating similar materials. Thus far, the selection of materials has been narrowed considerably due to the necessity of forming boards under alkaline conditions in order to maintain acceptable gas life characteristics.

Three sizing agents are now under consideration. They are Aquapel 360, Aquapel 486, and Cyron Size. The manufacturers of Aquapel recommend that their materials be used in conjunction with Kymene 557 or a cationic starch such as Cato 8 for improved retention of the size agent; Cyron Size requires no retention aid. These materials were described in Report Six.

In order to produce optimum sizing and gas life, particularly in sizing with Aquapel, several other variables must be considered. They are:

1. Order of addition of the sizing materials in relation to the charcoal. Indications from water absorption tests on boards formed from M & O pulp indicate a tendency for the charcoal to "open" the board. Addition of sizing agents after the incorporation of the charcoal in the pulp slurry may produce some sizing on the charcoal thereby improving the water repellency of the board, possibly affecting the gas life; or the sizing effect may be reduced because the charcoal has reduced the contact availability of the pulp fibers.

2. The point at which the size material is introduced. In the laboratory the sizing materials may be added to the 4% consistency stock slurry or it may be

1. Overdrying definitely improves the sizing of the board.
2. Addition of Cato 8 starch results in a higher degree of sizing at a given Aquapel 486 addition level.
3. More than a 0.1% addition of Aquapel 486 is necessary, even with a starch addition, to produce sizing to a degree that might be considered sufficient. (Federal Specification LLL-F-321b sets the maximum limit for the water absorption characteristics at 7% by volume.)
4. Addition of the Aquapel after the charcoal is more effective in producing size.

TABLE III

USE OF AQUAPEL 486
(Wood Conversion Company pulp)

Each board was formed with a 25% charcoal (C) addition

Sample 2256	Additions, % of fiber		Order of Addition ^a	Water Absorption, %, by volume	
	Aquapel 486 (A)	Cato 8 (S)		2 hr.	24 hr. ^b
72-1	--	--	--	17.0	30.6
76-3	0.1	--	AC	14.2	26.4
76-4 ^c	0.1	--	AC	8.6	16.6
76-1	0.5	--	AC	11.3	20.2
76-2 ^c	0.5	--	AC	8.8	17.4
76-9	0.1	0.5	ASC	9.8	18.6
76-10 ^c	0.1	0.5	ASC	7.3	16.2
76-5	0.5	0.5	ASC	7.4	16.2
76-6 ^c	0.5	0.5	ASC	6.2	13.9
76-7	0.5	0.5	CAS	6.0	14.5
76-8 ^c	0.5	0.5	CAS	5.8	13.7

^aAll additions were made to the 4% slurry.

^bSamples were resubmersed for 22 hr. after weighing at the end of the 2-hr. submersion period giving a total submersion period of 24 hr.

^cOverdried (cured) for 1 hr. at 300°F.

TABLE IV
USE OF AQUAPEL 360
(Wood Conversion Company pulp)

Each board was formed with a 25% charcoal (C) addition

Sample 2256-	Additions, % of fiber			Order of Addition ^a	Water Absorption, %, by volume	
	Aquapel 360 (A)	Cato 8 (S)	Kymene 557 (K)		2 hr.	24 hr. ^b
72-1	--	--	--	--	17.0	30.6
78-15	0.1	--	--	C-A	14.4	26.7
78-16 ^c	0.1	--	--	C-A	7.9	16.6
74-1	0.5	--	--	C-A	7.5	16.9
78-17 ^c	0.5	--	--	C-A	6.9	15.8
74-2	1.0	--	--	C-A	6.0	13.9
74-3	1.5	--	--	C-A	5.3	12.8
74-4	2.0	--	--	C-A	4.9	11.4
78-11	0.1	0.2	--	C-(AS)	12.6	23.4
78-12 ^c	0.1	0.2	--	C-(AS)	7.2	15.2
78-13	0.5	1.0	--	C-(AS)	7.5	16.0
78-14 ^c	0.5	1.0	--	C-(AS)	5.5	12.9
78-18	0.1	--	0.2	C-(AK)	20.2	35.1
78-19 ^c	0.1	--	0.2	C-(AK)	8.0	19.1
78-20	0.5	--	0.2	C-(AK)	7.5	19.4
78-21	0.5	--	0.2	C-(AK)	7.1	17.9

^aAll charcoal additions were made to the 4% slurry, all other additions were made to the 1% slurry; symbols enclosed in parentheses indicate materials were mixed before addition to stock.

^bSee comment (b) Table III.

^cOverdried (cured) for 1 hr. at 300°F.

TABLE VI

GAS LIFE TESTS OF SIZED BOARD
(Wood Conversion Company pulp)

Each board listed was formed with a 25% charcoal (C) addition

Sample	Additions, % of fiber					Order of Addition ^a	Gas Life, ^b	
	Aquapel 486 (A)	Aquapel 360 (A)	Cyron (W)	Cato 8 (S)	Kymene 557 (K)		PS, min.	CK, min.
2256-	486	360	(W)	(S)	(K)			
72-1	--	--	--	--	--	--	42.6	39.2
76-10 ^c	0.1	--	--	0.5	--	ASC	--	25.0
76-6 ^c	0.5	--	--	0.5	--	ASC	--	21.2
74-3	--	1.5	--	--	--	C-A	--	6.9
78-21 ^c	--	0.5	--	--	0.2	C-(AK)	--	24.6
80-23	--	--	1.0	--	--	C-W	--	30.8
80-24	--	--	4.0	--	--	WC	--	6.6

^aAll additions, unless preceded by a dash, were made to the 4% slurry; those preceded by a dash were made to the 1% slurry. Symbols enclosed in parentheses indicate materials were mixed before addition to stock.

^bThese values were not corrected to a standardized 5 g./100 cm.² loading as has been the practice.

^cBoards were overdried (cured) for 1 hr. at 300°F.

GAS LIFE EVALUATION OF SIZED BOARDS FORMED FROM M & O PULP

The use of Aquapel 486, Aquapel 360, and Cyron Size with Minnesota and Ontario pulp was discussed in Report Six; at that time gas life studies were not available. Testing of these boards has been interrupted in order to test the boards formed from the Wood Conversion pulp, which we thought should have priority because it does not contain any residual sizing as was shown to be the case with the washed M & O pulp. The available gas life values are given in Table VII.

3. The use of Cato 8 and Kymene 557 does not seem to affect the gas life appreciably.

FUTURE WORK

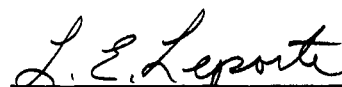
Work has been started on a series of boards which will contain Aquapel 486, Aquapel 486 and Cato 8, and Aquapel 486 and Kymene 557. The addition levels of Aquapel 486 and Cato 8 will be varied; Kymene 557 will be used at an addition level of 0.2% based on oven-dry fiber since it has been determined that greater amounts reduce sizing. This work is being done with a mixture of Wood Conversion Company pulps (17% of 10-855 and 83% of 10-890) which will be similar to the stock to be used for the pilot run at Bauer Bros. The purpose of this series is to further evaluate the use of Aquapel 486 and to familiarize ourselves with the stock to be used in the pilot run.

EFFECTS OF PLANING ON DIFFUSION BOARD

Variations in caliper between boards formed in our 14-1/2 by 14-1/2-inch sheet mold are difficult to control; great care in the operation of the sheet mold is necessary in order to hold the caliper variation within a single board to a minimum. Since gas life tests are indirectly dependent on sample thickness because of its relationship to charcoal loading and directly dependent on a certain threshold thickness and gas-charcoal contact time, it is desirable either to have consistent caliper in the samples or to be able to correct for caliper variations. Correction for caliper variation assumes that the relation of gas life to thickness is linear over the range of the variation, which may be an erroneous assumption for a large variation.

If there is a stratification of charcoal in the board, there would be a variation in the ash contents of various laminar sections of the board. With this in mind, sections of a board were submitted unplaned; planed on the top side; planed on the wire side; and planed on both sides for ashing determinations. The results of these determinations are not yet available.

THE INSTITUTE OF PAPER CHEMISTRY



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APPENDIX I (Continued)

USE OF SIZE AND WET-STRENGTH AGENTS WITH WOOD CONVERSION COMPANY PULPS
PULP: 52.2% 10-855 + 47.8% 10-853

Sample 2256-	Material	Additions ^b			Forming pH	Caliper, in.	Density, lb./cu. ft.	CO ₂ Diffusivity, -2 cm. ² /sec. x 10 ⁻²	Gas Life ^a		Water Absorption, %, based on dry volume	
		%, based on O.D. fiber	Order of Addition	Where Added					PS, min.	CK, min.	2 hr. submersion	24 hr. submersion
78-15	Charcoal ASC	25.0	1	4% slurry								
	Aquapel 360	0.1	2	1% slurry	8.2	0.341	20.47				14.36	26.72
78-16	Same as 78-15, cured 1 hr. at 300°F.				8.2	0.340	20.23				7.94	16.65
74-1	Charcoal ASC	25.0	1	4% slurry								
	Aquapel 360	0.5	2	1% slurry	8.4	0.336	21.40	2.87			7.49	16.86
78-17	Same as 74-1, cured 1 hr. at 300°F.				8.2	0.345	19.92				6.94	15.78
74-2	Charcoal ASC	25.0	1	4% slurry								
	Aquapel 360	1.0	2	1% slurry	8.4	0.337	21.15				5.96	13.86
74-3	Charcoal ASC	25.0	1	4% slurry								
	Aquapel 360	1.5	2	1% slurry	8.2	0.331	22.24		6.9		5.33	12.77
74-4	Charcoal ASC	25.0	1	4% slurry								
	Aquapel 360	2.0	2	1% slurry	8.3	0.337	21.77	2.71			4.91	11.45
78-18	Charcoal ASC	25.0	1	4% slurry								
	Aquapel 360	0.1	2	1% slurry								
	Kymene 557	0.2	2	1% slurry	8.2	0.342	20.46				20.18	35.06
78-19	Same as 78-18, cured 1 hr. at 300°F.				8.2	0.344	20.02				7.98	19.12
78-20	Charcoal ASC	25.0	1	4% slurry								
	Aquapel 360	0.5	2	1% slurry								
	Kymene 557	0.2	2	1% slurry	8.1	0.345	20.65				7.47	19.35
78-21	Same as 78-20, cured 1 hr. at 300°F.				8.2	0.337	20.56	2.61		24.6	7.07	17.94
80-22	Cyron size	1.0	1	4% slurry								
	Charcoal ASC	25.0	2	4% slurry	8.4	0.341	20.12				10.76	20.99
80-23	Charcoal ASC	25.0	1	4% slurry								
	Cyron size	1.0	2	1% slurry	8.0	0.335	20.39			30.8	6.33	16.68
80-24	Cyron size	4.0	1	4% slurry								
	Charcoal ASC	25.0	2	4% slurry	8.3	0.325	22.11	2.25			4.76	11.12
80-25	Charcoal ASC	25.0	1	4% slurry								
	Cyron size	4.0	2	1% slurry	7.7	0.334	21.68				6.32	16.14

Note: All samples were dried for 2.0 hr. at 105°C.

^aGas life values not corrected to standard 5 g./100 sq. cm. loadings.

^bAdditions reported as per cent active material added.

^cAddition is reported as total amount of starch in system. Aquapel 360 contains by weight starch.