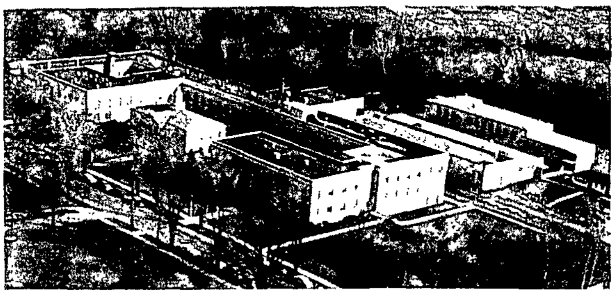

THE INSTITUTE OF PAPER CHEMISTRY, APPLETON, WISCONSIN

DEVELOPMENT OF AN IMPROVED DIFFUSION BOARD MATERIAL

Project 2256

Report Nineteen

A Monthly Report

to

U. S. ARMY CHEMICAL CENTER PROCUREMENT AGENCY

Report Period: April 29, 1962 to May 28, 1962

July 27, 1962

THE INSTITUTE OF PAPER CHEMISTRY

Appleton, Wisconsin

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Contract No.	DA18-108-405-CML-941
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THE INSTITUTE OF PAPER CHEMISTRY

Appleton, Wisconsin

DEVELOPMENT OF AN IMPROVED DIFFUSION BOARD MATERIAL

SUMMARY

Samples of pulp and boards from the April, 1962 Wood Conversion Company pilot trials were received and tested. The board product ranged in density from 22 to 24 lb./cu. ft. The dry strength of the board was superior to similar board produced in the Bauer pilot trials in May, 1961, while the wet strength was inferior, indicating poorer sizing. The 24-hr. water absorption of the April, 1962 pilot trial board was also poorer than the Bauer product, while the 2-hr. absorptions were comparable.

Boards formed in the laboratory from samples of pulp taken at different stages of washing in the pilot trials showed an increase in gas life with washing from 7 min. of CK life for pulp from the grinder chest to 49 min. of CK life after 45 minutes of washing. The pulp samples were tested for ash, pH and hot water solubles. The ash of the washed pulp was somewhat higher than the unwashed pulp indicating contamination, probably mineral fiber picked up in the stock line. The hot water solubility of the pulp decreased with increased washing and the gas life of lab-formed boards seemed to increase in proportion to the decrease in hot water solubles.

Hot water solubility and gas life data were collected for boards formed from some of the Wood Conversion Company pulps used in this program. Semilog plots of CK critical bed and PS life <u>versus</u> hot water solubles for sized boards suggested straight lines indicating a definite relation between gas life and water solubles for this pulp.

A series of laboratory drying studies were completed. Boards and stacks of boards were thermocoupled and dried in a circulating-air oven. This work indicated an unstable condition occurring around 335°F. in which the board might or might not ignite as the result of reactions within the board which produced temperatures above the oven temperature. In a discussion with personnel at the Wood Conversion Company, it was concluded that it was most likely that the pilot trial fires resulted from overheating due to radiation from exposed (to the board) steam coils located between the decks of the drier. It was also decided during the discussions that a second pilot trial should be made on the no. 2 (pilot) machine in order to determine whether the probability of fire is sufficiently low to make a production trial reasonable.

Mildew resistance tests were completed on sized boards treated with Cunilate [illegible], copper pentachlorophenate, and zinc oxide. The test used was a modification of the direct innoculation procedure outlined in Federal Specification [illegible]. Boards treated with Cunilate were most resistant to mildew, however, Cunilate has been found detrimental to gas life. Boards treated with zinc oxide were more susceptible to mildew growth than the blanks, and the boards containing copper pentachlorophenate had no better resistance than the blanks. The sized boards without fungicide treatment possessed some degree of mildew resistance under the test environment.

Work concurrent to this project at the Army Chemical Center included chemical analyses and pyridine reactivation of pilot trial board samples from the April, 1962 Wood Conversion trial and the May, 1961 Bauer Bros. trial. The board samples were analyzed for sulfur, sodium, chromium, copper, and pH and no significant differences were detected between the two pilot trial products even though their CK lives were different. Pyridine treatment increased the CK life of the Bauer samples from an average of 27 minutes to 45 minutes while the Wood Conversion samples increased from an average of 3.4 minutes to 20 minutes.

Plans were made for a second pilot trial as the result of the discussion with Wood Conversion Company personnel, the purpose of the second trial being to resolve the problems encountered in drying and further investigate some possible causes of the poor gas life of the first pilot trial product. The plans included washing of the stock, pH control, and limiting of the steam coil temperature in the drier to 300°F. A tentative date of June 5, 1962 was set for the trial.

EVALUATION OF PILOT TRIAL SAMPLES

Samples of pulp and of boards from the pilot trial conducted in Cloquet, Minnesota on April 17, 1962 were shipped to the Institute and to the Army Chemical Center for testing. At the Institute, specimens of the board samples were tested for density, carbon dioxide diffusivity, water absorption, beam strength, and wet and dry tensile strength. The results of these tests are shown in Table I in comparison with the properties of similarly formulated board produced in the May, 1961 Bauer pilot trials.

The several samples from the run varied in density and other properties, reflecting the difficulty of stabilizing control on a short run. The diffusivities of the boards were adequate even though the densities of the boards were higher than the desired density of 21 lb./cu. ft. The 2-hr. water absorption tests were almost as good as the results obtained in the Bauer Bros. pilot trials, but the 24-hr. water absorption was higher than obtained in the Bauer trial. These water absorption data are consistent with the relative results obtained in the laboratory using the 1961 and 1962 Wood Conversion Company pulps. Density variations seemed to produce a spread of some magnitude in the dry strength properties. The dry strength was superior to the Bauer trial product (probably due to differences in densities) but the wet strength was somewhat lower, reflecting the poorer sizing and wet strength effect.

The results of gas life tests on board samples from this pilot trial (presented in Report 18) were very poor. It is possible that the gas life was affected by the water soluble materials retained in the pulp due to insufficient washing (a relationship between hot water solubles and gas life has been derived and is discussed in another section of this report). Boards were formed in the [illegible]

TABLE I

PILOT TRIAL BOARD PROPERTIES

Sample 2256-2085-	Caliper, in.	Density, lb./cu. ft.	CO_2 Diffusivity, $cm.^2$ sec. x 10^{-2}	Water Absorption %, based on dry volume		Beam Strength Load, lb.		Beam Strength Modulus of Rupture, p.s.i.		Tensile Strength Dry		Tensile Strength 2 Hr. Soak		Tensile Strength 24 Hr. Soak	
				2 Hr. Soak	24 Hr. Soak	Machine Direction	Cross Direction	Machine Direction	Cross Direction	Machine Direction	Cross Direction	Machine Direction	Cross Direction	Machine Direction	Cross Direction
Wood Conversion Pilot Trial, April, 1962															
3.4	0.356	24.32	2.27			16.55	16.63	658.5	691.2	400	497	346	256	58.8	77.9
5				6.4	20.0										
6	0.342	22.82	2.68												
7				6.4	18.8										
9, 10	0.315	22.05	2.69			9.17	9.48	485.3	491.7	387	362	160	175	30.9	89.1
Bauer Bros. Pilot Trial, May, 1, 1961															
5-1,4,6	0.342	17.2	3.15	6.0	12.8										
5-5,6						8.87	10.10	481	482	389	411	214	221	115	130

to the pilot trial product (see Table II). Although the pulp samples taken during the trials were squeezed to a consistency of approximately 20% and, thus, were given an extra washing when diluted and formed in the laboratory, the gross differences in gas lives indicate that other factors such as the pH of the stock, forming temperature, water supply, and drying may have caused or contributed to the poor gas life of the pilot trial product.

TABLE II

GAS LIFE OF BOARD FORMED IN THE LABORATORY FROM PILOT TRIAL PULP SAMPLES

Sample 2256-	Origin of Pulp Sample	Estimated Charcoal Loading, g./100 sq. cm.	CK Life Min.	CK Life Critical Bed g./100 sq. cm.	PS Life Min.
2085-52-1	Grinder chest WCCO pilot trial	5.72	6.8	5.33	21
2085-52-2	20 min. washing WCCO pilot trial	5.52	44	3.88	27
2085-52-3	45 min. washing WCCO pilot trial	5.75	49	3.82	31
PR-1,2-127	Bauer Bros. Pilot trial, May, 1961	5.75	51	3.8	--

There seemed to be some discrepancy between the ash content of the washed pulps and the unwashed pulp (grinder chest sample); consequently, the ash tests were rerun. The retests showed a comparable discrepancy, leaving as the only explanation, the probability that the pulp was contaminated with mineral fiber as it was pumped to the machine chest (as was the case with the pulp used one year ago in the Bauer Bros. pilot trials). The results of these tests are shown in Table III.

TABLE III

SOME PROPERTIES OF PULP SAMPLES FROM THE APRIL 17, 1962
PILOT TRIALS AT THE WOOD CONVERSION CO.

	Ash, %			
Sample	First Test	Retest	pH of Hot Water Extract	Hot Water Solubles, %
Unwashed	1.52	1.60	5.6	7.2
20 min. washing	7.96	5.82	6.7	3.4
45 min. washing	6.76	5.48	6.2	2.7

This variability in ash content of the pulps made determination of charcoal retention by ashing of doubtful value.

EFFECT OF HOT WATER SOLUBLES ON GAS LIFE

When work was resumed on this project earlier this year, it was found that the pulp supplied by the Wood Conversion Company did not produce boards with gas lives equivalent to the boards produced the previous year using pulps cooked in the same way (see Report Seventeen). These pulps were found to differ somewhat in hot water solubility because of the method of collection; this year's pulp had a greater amount of hot water solubles than last year's.

Hot water solubility data and gas life data for boards prepared in the laboratory from some of the Wood Conversion Company pulps used during the course of this program were collected and semilog plots made of the critical bed charcoal loadings versus hot water solubles for boards containing additions of 0.5% Aquapel 360 and 0.2% Kymene 557. These plots suggest a straight line up to a critical bed of about 5.0 g./100 sq. cm. (see Fig. 1). Deviation from a straight line would be expected as the critical bed approaches the charcoal loadings used in the boards (5 to 6 g./100 sq. cm.) because the relationship of CK gas life to charcoal loading becomes nonlinear as the gas life becomes less than 20 minutes, i.e., the difference between the charcoal loading and the critical bed becomes less than one gram (see Fig. 1, Report 10).

PS life data were available on some of the sized boards formed from the Wood Conversion Company pulps. A semilog plot of PS life versus hot water solubility also indicates a definite relationship between the two variables, with most of the data falling along a straight line (see Fig. 2).

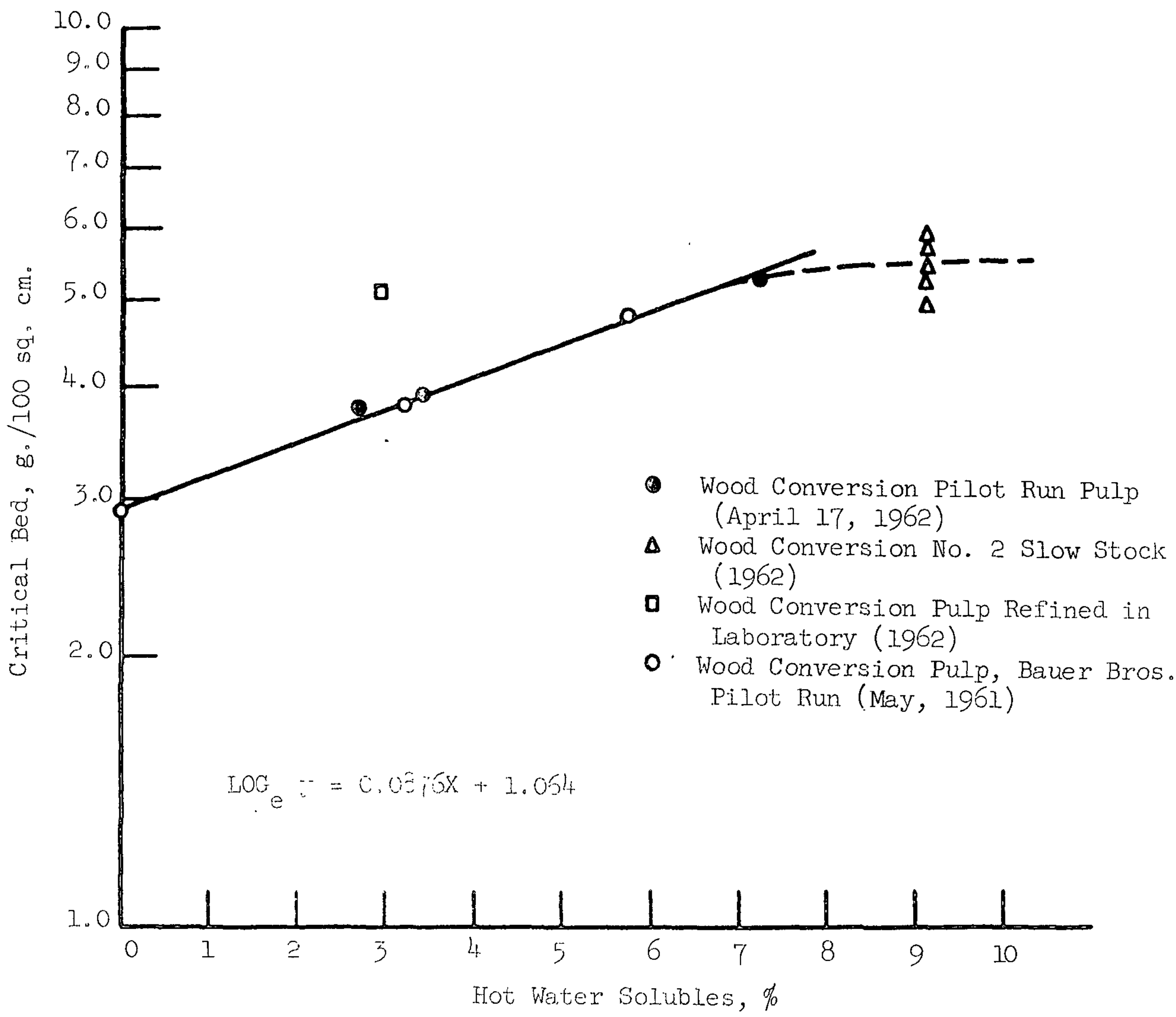

Figure 1. Relation Between Hot Water Solubles and Critical Bed for Sized Boards Made with Wood Conversion Co. Pulps

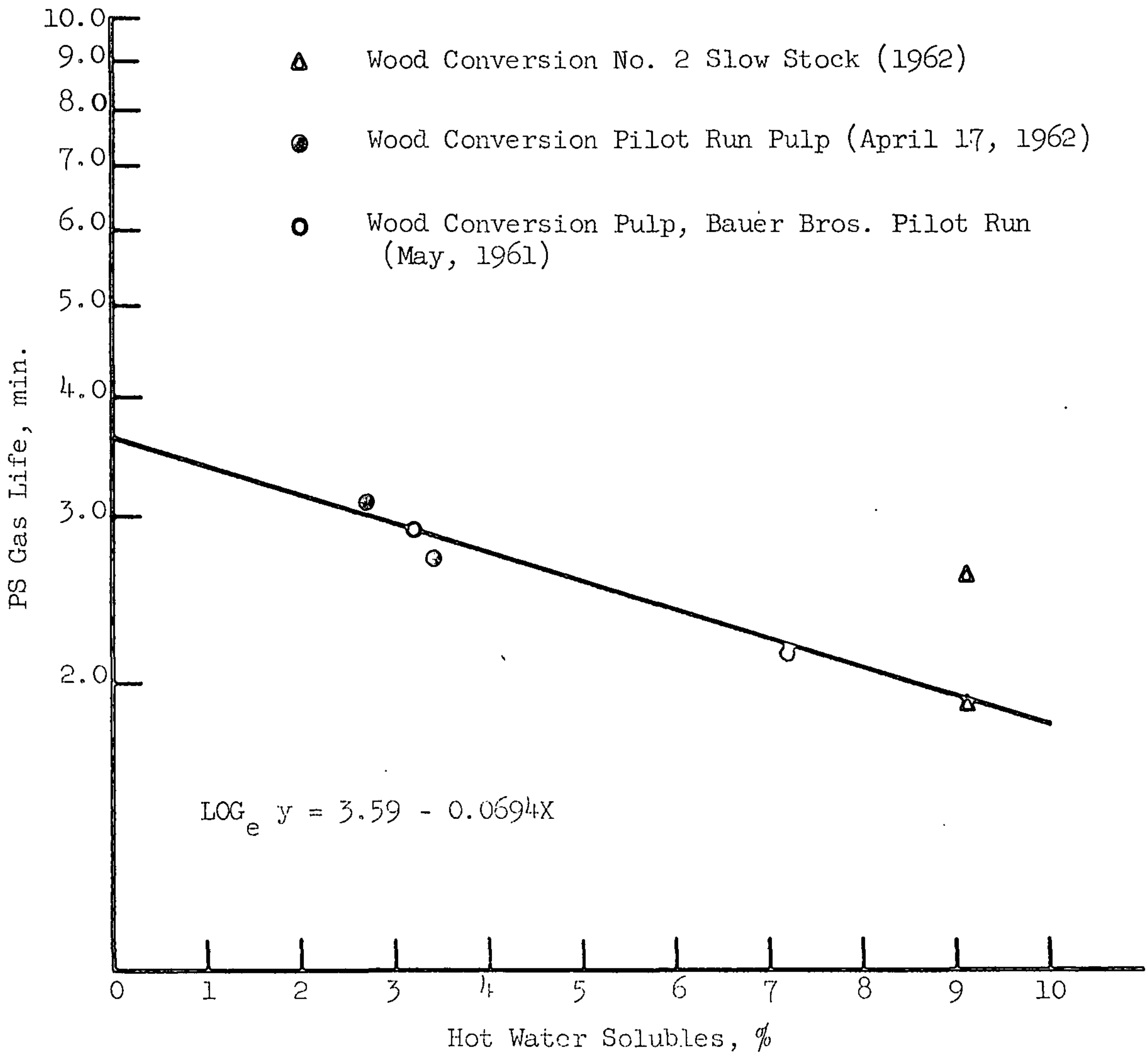

Figure 2. Effect of Water Solubles on PS Life in Sized Boards Formed From Wood Conversion Pulps

On the basis of these plots, the lower CK and PS lives obtained with this year's pulps appear to be attributable to the effect of the hot water solubles. Limited data for other pulps do not necessarily fall on the same line. This effect may vary with the history of the pulp, but the relationship of hot water solubility to gas life for a given type of pulp probably could be used as a criteria for pulp control and treatment in further operations--whether this relation would be similar for other pulp is not known. Although the hot water solubility test is not a rapid one, the knowledge that a minimum water solubles content is required for satisfactory gas life might be of value in setting up quality controls for a production operation.

THE EFFECT OF DRYING ON FIRE HAZARD

This work was a continuation of the work described in Report 18 (undertaken because of the fires which occurred). Pulp samples obtained from the April 17, 1962 trial at the Wood Conversion Company were formed into boards and dried in various ways in a circulating-air oven set at 335°F. Each board tested was sized with a 0.5% addition of active Aquapel 360 and a 0.2% addition of active Kymene 557 and contained at 25% addition of charcoal. The boards were formed in an 8-1/2 by 8-1/2 in. sheet mold and wet-pressed for 10 minutes at 100 p.s.i. Thermocouples were inserted in the specimens and temperatures were recorded with a Speedomax six-point recorder.

The first test was made with a board 1/2-in. thick, formed from unwashed pulp. It was cut into four 4 1/2-in. squares which were stacked in the oven and dried at the minimum air circulation setting of the oven. Thermocouples were inserted between the first and second layers, in the third layer and between the third and fourth layers. After 320 minutes of drying, the oven was shut down for 15 hours (overnight) with the temperatures between layers at approximately 220°F. When the test was resumed, the temperature rose rapidly to 220°F., leveled off slightly and reached 335°F. after 3 hours; the temperature continued to rise and the specimen was badly charred and glowing when removed from the oven.

The second test was conducted with a 1/4-in. board formed from the unwashed pulp. This board was cut in half and the two halves were stacked in the oven to simulate a single 1/2-in. board. Thermocouples were placed inside the bottom layer, between the layers, inside the top layer, and just under the top surface of the top layer. The air circulation was set at the maximum setting. After 85 minutes, the board temperatures reached 335°F.; the temperature of the top layer then rose to [illegible]°F., while the temperature of the bottom layer rose to 340°F

The board remained at these temperatures for 20 minutes, then dropping over a period of the next 20 minutes to the oven temperature. The board temperature was still 335°F. when the test was discontinued 30 minutes later. There was no sign of charring.

A board one-half inch thick was formed from washed pulp (sample obtained after 45 min. of washing) for the third trial. Two thermocouples were inserted in the middle of the board; a thermocouple was inserted near the bottom surface of the board and a thermocouple was inserted near the top surface of the board. The air circulation was set halfway between the maximum and minimum settings and the fresh air intake for the oven was throttled to the minimum value. The board temperature reached 335°F. after 85 minutes, continued to 345°F. then dropped slowly over a period of 150 minutes to 335°F.

The fourth test was set up in the same manner as the third test with the exception that the specimen was wrapped in aluminum foil. This was done so that the specimen would be in an environment of essentially stagnant and humid air and protected from the effects of radiant heat emitted from the oven walls. The drying rate was reduced; the board temperature approached 335°F. after 170 minutes. The temperature in the center of the board reached 340°F. and began to drop. The rest of the thermocouples in the board were indicating temperatures slightly below the oven temperature and gave no sign of exceeding that temperature after 200 minutes when the test was discontinued.

These tests indicate that exothermic reactions are occurring in the board at temperatures below the actual ignition temperature. Heat may be absorbed by the board from external sources, (the surrounding air or by radiation) or may originate internally (from chemical reactions or from adsorption on the active charcoal) and will tend to raise the board temperature. The principal factor tending to dissipate this heat and hold down the board temperature is the evaporation of water. Previous work had assumed that an ignition condition would not be reached until the board was sufficiently dry so that this dissipation of heat would be negligible. However, if this dissipation is reduced because of poor air circulation, high humidity of the surrounding air or a high ratio of mass to surface, and if input heat is increased because of more active exothermic reactions in the board and/or greater opportunity for radiation to the board, it is possible that fires could originate under conditions previously considered fairly safe. The high rate of air circulation in the laboratory oven probably has prevented such fires in the past because it has favored rapid and uniform drying. At an oven temperature of 335°F. we were apparently in a marginal condition where ignition did not quite occur. This work does suggest that fires can be prevented by holding the drying temperature to a sufficiently low value, such as 300°F. More accurate determination of the maximum "safe" temperatures over all the possible combinations of drying conditions would require a prohibitively long time.

At this time, an opportunity arose to discuss drying with two representatives of Minnesota and Ontario Paper Co., (Dr. Burton and Mr. Johnson). Without an opportunity to consult any records, Dr. Burton could not recall any fires occurring in the run of unsized diffusion board with they had made and could not recall the exact drying conditions used. He indicated that the type of drier used by Minnesota and Ontario Paper Co. and by Wood Conversion Co. is the same type used by 90% of the industry. Fires in these driers are not uncommon but tend to occur on light weight board where overdrying takes place readily at the start of a run or after an interruption in production. Fires also occur in shipment or in storage if the board is stacked without sufficient cooling; (there is little opportunity for self-heating to be dissipated from a large stack of insulating material). At Minnesota and Ontario Paper Co., the drier [illegible] at 175 p.s.i. with some superheat and the air temperature is controlled to a typical level of 350°F. on the entrance and 280°F. on the exit. Air circulation was stated to be good.

A special visit was made to Cloquet on May 23 and 24 to discuss with Wood Conversion Co. personnel the possible cause of the fires in No. 2 drier and the relationship of this drier to that on no. 1 machine. The latter has a 5-zone drier approximately 450 feet long. Each zone has steam coils in each deck and reheaters which heat the air circulated through that zone. In contrast, the no. 2 machine has one zone of a commercial drier but the boards are placed in this zone and left there until dry.

Banks of steam coils are between the decks of board and are heated from a steam supply at 250 p.s.i. Air temperature at one point in the drier is used as a guide for manual operation of the steam valve; thus it is possible that full steam pressure was on the coils during the early part of the run, permitting a considerable amount of radiant heat to be transferred to the boards.

The zone used on no. 2 is 50 feet long; however the air circulation is effective in only part of this zone. The air enters near the discharge end but is drawn off at a point approximately 20 feet from the entering end, leaving this 20 feet as a "seal section" with very little air circulation but containing hot steam coils. It was in this section that the first fire started.

After a thorough discussion of the drying and fire problem, there was general agreement that another trial should be made on no. 2 machine with different control of drying in order to determine whether the probability of fire can be held sufficiently low to make a trial on the commercial machine reasonable. This trial was scheduled for June 5, 1962.

THE USE OF FUNGICIDES

The characteristics desired in the improved diffusion board include resistance of the surface of the board to mildew and to the growth of similar spore formations which would affect the efficiency of the material. As with many of the desired properties, no specific minimum level of performance could be set. Testing of mildew resistance is subject to many variables. A suggestion was received that initial testing be based upon the direct inoculation procedure outlined in Federal Specification CCC-T-191b, Method 5751 and this procedure was used initially. However, it was found to be too mild a test to be useful in separating various treatments because no growth occurred on the untreated samples. As described in Reports Six, Eight, Eleven, and Seventeen, this method was modified to a more drastic one in order to get some spread in results.

In the early screening experiments, additions of various fungicides to unsized boards were evaluated. From these preliminary tests, Cunilate 2419 (copper 8-quinolinolate) and copper pentachlorophenate seemed to have some promise. Boards were made using these materials and also zinc oxide (which had been suggested as both a gas life stabilizer and a fungicide), and also containing the standard formulation of 0.5% Aquapel 360 and 0.2% Kymene 557 which had been adopted in the meantime. Gas life on these boards as reported in Report Seventeen showed a disappointing detrimental effect of Cunilate on both CK and PS life. (These tests were made with pulp which in itself had poor gas life so that the results are somewhat in question.) The copper pentachlorophenate had less effect on gas life.

Tests of mildew resistance of these boards have now been completed and are shown in Table IV. These results show that only Cunilate produced effective resistance to mildew. Boards containing zinc oxide seemed more susceptible than the blanks, and those containing the copper pentachlorophenate were no better than

TABLE IV

FUNGUS RESISTANCE OF BOARDS TREATED WITH FUNGICIDES

Boards Formed From Wood Conversion Co. Pulps; Sized With Aquapel and Kymene

Sample 2256-2085-	Fungicide Added	Addition To Fiber (Active Material), %	Incubation Period (See Rating Key) 4 Days Specimen 1	2	3	7 Days Specimen 1	2	3	10 Days Specimen 1	2	3	14 Days Specimen 1	2	3	21 Days Specimen 1	2	3	28 Days Specimen 1	2	3	35 Days Specimen 1	2	3
14-4,5	Blank	--	0	0	0	0	0	0	0	0	0	C	0	0	1+C	1+	0	2+C	1+	1+	2+C	2+	2+
34-1	Blank	--	0	0		0	0		0	0		+	+		+	+							
--	Blank, unsized, aged one year	--	+	+		+	+		+C	+C		+C	+C		1+C	+C		1+C	+C		2+C	1+C	
13-1	Copper pentachlorophenate	1.0	0	0	0	0	0	0	?	C	0	+	C	0	1+	+C	0	1+	1+C	1+	2+	2+C	2+
13-2,3	Copper pentachlorophenate	1.0	0	0		0	0		0	0		+	0		1+C	1+C		2+C	2+C		2+C	2+C	--
13-4,5	Copper pentachlorophenate	0.6	0	0	0	0	0	0	0	0	?	0	?	+	0	+	1+	0	1+	2+	0	2+	2+
13-6,7	Copper pentachlorophenate	0.3	0	0	0	0	0	0	0	0	0	C	0	0	1+C	1+	0	2+C	2+	1+	2+C	2+	2+
13-8,9	Cunilate no. 2419 (10% copper-8-quinolinolate)	1.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13-10, 14-1	Cunilate no. 2419 (10% copper-8-quinolinolate)	0.6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
14-2,3	Cunilate no. 2419 (10% copper-8-quinolinolate)	0.3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
31-2	Zinc oxide (Kadox)	0.5	0	0		+	+		2+	1+		3+	2+		3+	3+							
31-4	Zinc oxide (Kadox)	1.5	0	0		+	0		+	0		1+	C		1+	C							
31-6	Zinc oxide (Kadox)	2.5	0	0		+	+		1+	+		2+	1+		2+	1+C							

Rating Key:

0 = No growth
? = Questionable growth
+ = Very slight growth
1+ = Slight growth
2+ = Moderate growth
3+ = Heavy growth
C = Contaminate other than _C. globosum_

the blanks. Unfortunately, the Cunilate has been shown to have a detrimental effect on gas life, thus leaving the conclusion that the effective fungicides are detrimental and cannot be considered. It should be noted, however, that the need for a fungicide has not yet been established. The boards without fungicides are not highly susceptible to mold attack under the test environment used. For comparison, Chaetomium globosum will generally completely overgrow untreated paper and board samples in two weeks when evaluated by this method. Therefore, it appears desirable to eliminate the use of any fungicide until field experience or other information permits the setting of a more quantitative specification showing the need for more mildew resistance than that of the untreated board.

Some minor variations have been made in the test method since it was described previously. The latest procedure is described in the Appendix along with the more detailed observations on the behavior of these specimens.

CONCURRENT WORK AT THE ARMY CHEMICAL CENTER

CHEMICAL ANALYSES

Samples of boards from the Wood Conversion Co. April, 1962 pilot trial and the Bauer Bros. May, 1961 pilot trial were analyzed for sulfur content, sodium content, total chromium content, hexavalent chromium content, total copper content, divalent copper content, and pH. The results of these analyses are listed in Table V.

TABLE V

CHEMICAL ANALYSES OF DIFFUSION BOARD SAMPLES FROM WOOD CONVERSION CO. PILOT TRIAL NO. 1

Board No.	S, %	Na, %	Total Cr, %	Cr^{+6}, %	Total Cu, %	Cu^{+2}, %	pH[a]
Bauer Bros. Pilot Trial							
2	0.48	0.29	0.21	0.02	1.39	0.59	5.5
5	0.44	0.26	0.18	0.02	1.14	0.99	5.4
8	0.40	0.44	0.31	0.02	1.36	1.10	5.5
Av.	0.44	0.33	0.23	0.02	1.30	0.89	5.5
Wood Conversion Pilot Trial							
10	0.41	0.39	0.24	0.02	1.62	1.09	5.4
13	0.39	0.21	0.31	0.02	1.70	0.62	5.3
16	0.43	0.35	0.09	0.02	1.56	1.10	5.5
Av.	0.41	0.32	0.21	0.02	1.63	0.94	5.4

[a] pH Test: 0.9-0.93 g. diluted to 250 ml. with distilled water.

Comparison of these analyses showed no detectible differences even though the gas lives of the boards were widely different. Samples of pulp and liquor from the Wood Conversion Co. trial were sent to the Army Chemical Center for additional analyses.

PYRIDINE REACTIVATION

Experiments have been carried out in which board samples were degassed in an evacuated desiccator and then treated with pyridine by bringing the desiccator to atmospheric pressure with air bubbled through pyridine. The pyridine pickup of the samples was measured by weight difference and the gas lives of the samples were tested and compared to untreated samples.

The results of the pyridine treatments on board samples from the 1961 Bauer Bros. pilot trials and the April 17, 1962 Wood Conversion Co. pilot trials are presented in Table VI. The pyridine treatment increased the CK life of the Bauer Bros. samples from an average of 27 minutes to an average of 45 minutes while the treatment of the Wood Conversion Co. samples increased the CK life from an average of 3.4 minutes to an average of 20 minutes. Although the per cent increase for the Wood Conversion Co. boards was much greater than for the Bauer Bros. boards, the Wood Conversion Co. boards were not increased to a satisfactory level of CK protection. The CK lives of the pyridine treated specimens of the Wood Conversion Co. boards were somewhat varied, indicating some interference with the surface adsorption capacity of the charcoal in some areas of the boards.

TABLE VI

EFFECT OF PYRIDINE TREATMENT ON PILOT TRIAL DIFFUSION BOARD SAMPLES

Board Sample	AR Weight, g.	Degassed Weight, g.	Pyridine Treatment	Weight After Pyridine Exposure, g.	Weight Increase After Exposure, g.	Initial CK Life, min.
Bauer Bros. Trials; May, 1961						
3-3-P-1	36.02	35.90	no	--	--	20.3
-2	38.33	Not degassed	no	--	--	23.5
-3	37.82	37.66	no	--	--	--
-7	37.02	36.90	no	--	--	--
-8	39.91	39.76	no	--	--	38.0
3-3-P-4	39.63	39.50	yes	39.61	0.11	--
-5	38.74	38.62	yes	38.70	0.08	42.6
-6	38.52	38.39	yes	38.55	0.16	--
-9	38.92	38.74	yes	38.89	0.15	48.3
Wood Conversion Co. Trials; April, 1962						
3-5	51.66	51.52	no	--	--	3.1
10-3	39.10	39.06	no	--	--	3.6
3-6	51.34	51.13	yes	51.27	0.14	11.9
3-2	51.55	--	yes	51.70	0.15	27.4
3-4	52.08	--	yes	52.07	--	13.9
3-7	51.51	51.30	yes	51.44	0.14	12.8
10-4	40.00	--	yes	40.06	0.06	35.5
10-6	39.60	--	yes	39.73	0.13	15.0
10-1	39.40	39.21	yes	39.40	0.19	24.0
10-2	39.45	39.26	yes	39.40	0.14	20.2

PLANS FOR A SECOND PILOT TRIAL AT WOOD CONVERSION CO.

The first pilot trial was not satisfactory from the standpoint of drying and gas life. As the result of a discussion with Wood Conversion Co. personnel, a second pilot trial was deemed necessary and desirable before proceeding with plans for a full scale run in order to be certain that the problem of ignition during drying was resolved and in order to further investigate the possible causes of poor gas life in the first Wood Conversion Co. pilot trial.

Plans for a second trial were discussed at Wood Conversion Co. These plans included additional washing of the stock and control of the stock pH with sodium hydroxide. In the first trial, the stock was washed by passing it over the machine; in the second trial, an attempt would be made to pass the stock over a washer to provide more thorough washing (some doubt was expressed that stock of such low freeness would form a cake on the pulp washer) and also to do some washing on the machine. The first trial had been run without pH control because it was thought that the furnish would be sufficiently alkaline to keep the forming pH about 8, as the pH of the water supply was approximately 7. Since it is known that an acid condition can seriously affect CK gas life, it was decided that closer pH control would be necessary. Also, the steam coil temperature in the drier would be limited to 300°F. for this trial. At the conclusion of the discussion at Wood Conversion Co., a tentative date of June 5, 1962 was set for a second pilot trial.

THE INSTITUTE OF PAPER CHEMISTRY

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APPENDIX

TESTING OF MILDEW RESISTANCE

The method of testing the diffusion board was changed in several minor respects from previous testing and is repeated as follows:

1. Test specimens, 2 inches square, were cut from the samples on a table saw. Three squares of each treatment were examined for the March 15, 1962 samples. Because of reduced sample size, only two squares of each treatment were examined for materials submitted April 10, 1962.

2. Squares were submerged, for 1-1/2 hr., in mineral salts solution of the following composition:

NH_4NO_3	3.0 g.
K_2HPO_4	1.0 g.
KCl	0.25 g.
$MgSO_4 \cdot 7H_2O$	0.25 g.
Distilled water	1000 ml.

   A ratio of 66 ml. of solution per square was maintained.

3. The test specimens were placed in sterile Petri dishes; 25 ml. of sterile mineral salts agar (above salts solution plus 2.0% agar) were added, and the agar was allowed to solidify.

4. A spore suspension of *Chaetomium globosum* was prepared by washing the growth from a 14-day culture (grown on a 0.5 by 3 in. strip of blotter paper according to TAPPI Method T 205 m-50) on salts agar. Growth was suspended in 50 ml. of sterile distilled water and spore clumps were dispersed by shaking with glass beads.

5. Test specimens were inoculated with one ml. each of the spore suspension and plates incubated at 28°C. Periodic examinations were made to determine fungus development.

6. Because of the drying which occurred during incubation (probably due to continued water uptake by the test specimens not completely wetted by the soaking procedure), additional sterile water was placed on the specimens when needed--usually five ml. per square.

RESULTS

The test results are presented in Table IV. The only treatments showing a significant fungistatic effect were those containing Cunilate, all of which were free of mold growth for the entire five weeks incubation. One of the three replicates of board containing 0.6% copper pentachlorophenate was free of growth, while the other two were moderately overgrown which indicates the treatment was not uniform throughout the sample. With regard to susceptibility to fungal attack, the difference in rate of mold development on the control samples shows that there was a considerable variation between board samples made at different times. It was also evident that there was a difference in absorption of solution during soak periods, although this was not necessarily linked to the mold phenomenon.

Sporulation of C. globosum was again, as in prior testing, confined primarily to the edge of the sample, where it was in contact with the medium. Where ratings of 2+ were given, however, it is likely that mycelial penetration of the sample has become quite extensive. The mycelial growth, being mainly submerged, is not visible, and the fact that sporulation, which is commonly a surface phenomenon, occurs at a particular site, is not proof that the fungus has been confined to that area.

By increasing the soaking period and adding sterile water during the incubation period whenever severe drying of the agar became evident, all samples were adequately wetted to support growth of the fungus. These procedures, however, also introduce a leeching factor, which to some extent would "penalize" the more water-soluble test materials but without wetting we were unable to obtain fungus development on these materials. Despite wetting, the moderate amount of fungus development on controls, even after five weeks of incubation, indicates that diffusion board is not highly susceptible to mold attack under this test environment. For comparison, C. globosum will generally completely overgrow untreated paper and board samples in two weeks when evaluated by this method.