THE INSTITUTE OF PAPER CHEMISTRY

Appleton, Wisconsin

DEVELOPMENT OF AN IMPROVED DIFFUSION BOARD MATERIAL

Project 2256

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TABLE OF CONTENTS

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INTRODUCTION

This report covers the period ending January 28, 1961. During this period a method for determining the charcoal content of diffusion boards was set up; the effects of hot water washing on the Minnesota and Ontario pulp were investigated; and a pulp made from repulped newspapers was evaluated on a comparative basis against the Minnesota and Ontario pulp.

The effect of pH control with alum additions, using the repulped newspaper, was evaluated as a basis for a similar study in the future with the Minnesota and Ontario pulp. This is to serve as groundwork for studies of various rosin sizes and other sizing materials which may require alum or acid conditions for precipitation on the pulp fibers.

DETERMINATION OF CHARCOAL CONTENT OF DIFFUSION BOARDS

After discussion concerning possible methods for determining the amount of charcoal present in a diffusion board sample, it was decided that ashing would be the most expedient method at the present. Other methods considered involved extraction and quantitative analysis of the copper or the chromates present in the charcoal. For clarification as to what materials we can expect to find in the ASC charcoal which might serve as another means of quantitative determination and also as a means of evaluating the effectiveness of the charcoal in a sized or otherwise treated board, a copy of SPEC-MIL-C-13724 was ordered through our library.

It has been noted that some of the materials present in the ASC Charcoal are water soluble. For this reason, it was desirable to determine the variations in ash content of samples dispersed in water at 1% solids for varying periods. The difference in ash content of samples taken from the top and the bottom of the charcoal drum was 0.20%, with an average value of 24.0% ash content. One half-hour's contact time with water reduced the ash content to 23.6%, one hour to 23.50%, and four hours' contact time to 23.3%.

The charcoal content of a board sample was calculated according to the following equation:

$$\% \text{ charcoal} = \frac{b - a}{c - a}$$

where: a = % ash in a blank (board containing no charcoal)

b = % ash in the sample

c = % ash in charcoal corrected for contact time with water.

Ashing of the board samples is carried out at 900°C. according to Institute Method 422.

Results of ashing tests of board made from the sized Minnesota and Ontario pulp are shown in Table I.

TABLE I

RESULTS OF ASHING TESTS

Sample 2256-	Description	Ash Content, %	Charcoal Content, %
12-3	Blank	0.59	-
17-1	25% Charcoal addition (based on ovendry fiber)	5.50	21.25
17-6	25% Charcoal addition (based on ovendry fiber)	5.00	19.32
26-5	Hot-water washed, 25% charcoal addition (based on ovendry fiber)	4.96	19.25

EFFECTS OF HOT WATER WASHING ON MINNESOTA AND ONTARIO PULP

The pulp shipped to us by the Minnesota and Ontario Paper Company contained a small amount of wax-rosin sizing, with the exception of a small hand-dewatered sample containing no sizing.

These pulps were tested for water solubles and pH with the results shown in Table II.

TABLE II

TESTS OF WATER-SOLUBLE EXTRACTS

	Hot Water Extractables, %[a]	pH of Hot Water Extract[b]	pH of Cold Water Extract[b]
Rosin-free pulp	2.35	5.8	6.4
Wax-rosin sized pulp	2.24	4.8	5.2

[a] Institute Method 10 (modified)

[b] TAPPI 435 m-52

A set of boards was formed from the unwashed sized pulp as described in Report 3. In order to determine the effect of the sizing agent and the water solubles, other sets were prepared from the limited supply of unsized pulp and from sized pulp after washing.

The pulp was washed for three hours (on a sheet of muslin attached to a wooden frame) with water at 44°C., having a pH of 9.0. The pH of the water squeezed from a sample of pulp was used as a test for the amount of solubles removed from the pulp. The pH of the squeezings at the outset of the operation was 6.7 and, at the end of three hours, 7.95. (A pH of 8.0 was arbitrarily accepted as the end point.)

The boards were formed from a 1% slurry and wet pressed for ten minutes at 150 p.s.i. The boards were dried at a standard drying temperature of 105°C. It was intended that all of the pulp slurries would have a 25% furnish (based on ovendry fiber) of charcoal; however, the unsized pulp was given a 20% furnish of charcoal as the result of an error in calculation.

Samples of these boards were submitted for ash determination and were also sent to the Army Chemical Center on January 16 for gas life tests. Data presently available are given in Table III.

TABLE III

BOARDS FORMED FROM MINNESOTA AND ONTARIO PULP
WITH CHARCOAL FURNISH

Sample 2256-	Charcoal-Water Contact Time, min.	Forming pH	Sheet Mold Drainage	Drying Time, hr.	Caliper, in.	Density, lb./ft.^{3}	CO_2 Diffusivity, cm.^{2}/sec. x 10^{-2}
22-1	~30	>7.9	Water-leg + Vacuum	3.5	0.259	21.95	2.44
22-2	~50	>7.9	Water-leg	4.0	0.250	22.50	2.13
Hot Water Washed Pulp							
26-1	45	8.6	Vacuum	2.0	0.350	21.25	2.56
26-2	70	8.6	Vacuum	2.0	0.348	21.39	2.43
26-3	95	8.6	Vacuum	2.0	0.347	21.47	2.49
26-4	200	8.6	Water-leg	2.0	0.336	20.49	2.37
26-5	255	8.6	Water-leg	2.0	0.287	21.50	2.37
26-6	290	8.6	Water-leg	1.75	0.294	21.94	2.35

USE OF REPULPED NEWSPAPER

Repulped newspaper is the major constituent of the insulating board as produced by some companies, e.g., the Homasote Company. Its easy availability could make it an attractive source of pulp for laboratory use in addition to or in place of the Minnesota and Ontario pulp if the latter should prove to be unsuitable.

An investigation of the effects of pH, controlled by either aluminum sulfate or sulfuric acid, is needed as groundwork for future sizing investigations. The production of boards from repulped newspaper under various pH conditions is covered in this section; similar work with the Minnesota and Ontario pulp will be carried out in the next report period.

Two boards were formed without a charcoal furnish to serve as blanks. Four boards were formed from the same batch of pulp after the addition of a 25% charcoal furnish (based on ovendry fiber). A four per cent slurry of the stock was found to have a pH of 5.6; this increased to 7.6 after the addition of charcoal. The stock in all cases was diluted to 1% in the deckle box with city water having a pH of approximately 9, and drained by means of a water-leg and vacuum application; drying was done at 105°C.

A second batch of pulp was used to produce the pH controlled boards. A four per cent slurry, (having a pH of 5.2), was given a 25% furnish (based on ovendry fiber) of charcoal, which resulted in an increase in pH to 6.9. The slurry was divided into two equal portions. The pH of one portion was adjusted to 5.0 with alum and the diluent water used in the deckle box was adjusted in the same manner. The pH of the other portion was adjusted to 5.0 with sulfuric acid and the diluent water in the deckle box was adjusted to

5.0 with the acid. Two boards were formed from each portion, using one portion alternately with the other for the formation of the boards so as to reduce the effect of the varying charcoal-water contact times.

The newspaper pulp produced board somewhat denser than board formed from the Minnesota and Ontario pulp at comparable pressings (ten minutes at 150 p.s.i.). In order to lower the density of the board, it was necessary to reduce the wet pressing to five minutes at 25 p.s.i. As would be expected, the more pronounced tendency for this pulp to be affected by pressing also evidenced itself in lower carbon dioxide diffusivity values in the board samples than the boards produced from the Minnesota and Ontario pulp. Presently available data for these boards is given in Table IV.

TESTING

Samples of boards tested in the Institute laboratories for diffusivity and smoke penetration were submitted to the Contract Project Officer on January 16, 1961 for testing to establish the validity of our test methods.

Problems were encountered in the operation of the DOP apparatus, stemming from excessive drift and fluctuation at the zero and 100% settings on the penetrometer amplifier and lack of control over the particle size of the smoke generated. A second pressure regulator was installed in the air line feeding the generator in order to reduce the effects of line pressure changes in the air flow to the generator. Schematic diagrams of the temperature control apparatus and the penetrometer amplifier were requisitioned and received; this equipment will be checked for malfunctions before proceeding with any further testing.

TABLE IV

BOARDS FORMED FROM REPULPED NEWSPAPER

Sample 2256-	Charcoal-Water Contact Time, min.	Forming pH	Wet Pressing Time, min.	Wet Pressing Pressure, p.s.i.	Drying Time, hr.	Caliper, in.	Density, lb./ft.^{3}	CO_2 Diffusivity cm.^{2}/sec. x 10^{-2}
Boards Formed Without Charcoal Furnish:								
33-1	-	-	10	100	16	0.210	28.18	0.93
33-2	-	-	10	150	15	0.251	23.56	1.20
Boards Formed With 25% Charcoal Furnish:								
33-3	39	7.6	10	150	2	0.328	22.87	1.86
33-4	87	7.6	10	150	2	0.332	23.37	1.71
33-5	110	7.6	10	150	2	0.307	24.75	1.40
33-6	145	7.6	10	150	2	0.324	25.53	1.79
Boards Formed Under Controlled pH Conditions: pH Controlled With Additions of Alum:								
37-1-A	87	5.0	5	25	15.55	0.393	19.29	2.30
37-3-A	118	5.0	5	25	15.12	0.377	19.16	2.18
pH Controlled With Additions of Sulfuric Acid:								
37-2-B	107	5.0	5	25	15.33	0.364	19.05	2.29
37-4-B	140	5.0	5	25	14.82	0.377	18.90	2.34

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