THE INSTITUTE OF PAPER CHEMISTRY

Appleton, Wisconsin

DEVELOPMENT OF AN IMPROVED DIFFUSION BOARD MATERIAL

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SUMMARY

The current report covers tests of density, carbon dioxide diffusivity, and smoke penetration by the Army Chemical Center, indicating fairly good correlation with corresponding tests made at the Institute. First gas life evaluations were received and indicated a fair degree of protection against cyanogen chloride (CK) for boards made with the commercial pulp most readily available (but containing some sizing). Boards made with this pulp without size or after washing had better CK life, as did those made with repulped newspapers.

When pH of boards is adjusted to 5.0 with either sulfuric acid or alum, CK life is reduced seriously, suggesting that sizing and other treatments may be limited to those suitable for alkaline conditions. Initial trials of sizing, wet strength, and fungicidal treatments were made but test results are not yet available.

The preceding program on diffusion board was reviewed with Forest Products Laboratory personnel. As a result of information from the Contract Project Officer on tests made with various pulps, further information was requested from Armstrong Cork Company and Wood Conversion Company, both of whom offered to furnish pulps for further study. Wood Conversion Company also suggested the possibility of using their mineral fiber process for diffusion board, substantially eliminating the cellulosic fibers and permitting different possibilities in sizing, flameproofing, and fungus resistance.

INTRODUCTION

This program has for its objective the development of an improved diffusion board material, the desired product having the protective characteristics (diffusion, resistance to aerosol penetration, and gas life) of the presently available board but with improved properties which would make it more suitable for field use. Monthly Progress Report One described the background for the program and the proposal and authorization. Report Two described a visit to the Army Chemical Center by personnel of The Institute of Paper Chemistry for discussion of the program, the initial assembly of equipment, and an initial request for suitable materials. Report Three described the receipt of these materials, the standardization of test methods for density, carbon dioxide diffusion, dioctyl phthalate smoke penetration and gas life, and the initial formation of boards. In Report Four, methods for determination of charcoal content of boards were described, and tests were made of the effect of washing on the first pulp received (from Minnesota and Ontario Paper Company), and on a few boards made with repulped newspaper. In the current report, additional discussion of test methods and contacts with various companies are described along with preliminary tests of the effect of pH, fungicides, sizing, and wet-strength agents.

TEST METHODS

CO-ORDINATION WITH ARMY CHEMICAL CENTER

On one of his visits, Mr. Condon (Contract Project Officer) brought with him the results for density, carbon dioxide diffusion, and smoke penetration on several boards which we had submitted for comparative testing. These results are shown in Table I in comparison to the results which we had obtained by our own tests. It appears that there is fair correlation between the two laboratories on these tests, although the Army Chemical Center does seem to show a consistently lower density and a consistently higher diffusivity. In all boards they found a smoke penetration of less than 0.001%. Mr. Condon advised that they tend to run their density tests on boards under quite dry conditions; this might account for part of the difference.

TABLE I

COMPARISON OF TEST BY THE INSTITUTE OF PAPER CHEMISTRY (IPC) AND THE ARMY CHEMICAL CENTER (ACC)

Sample 2256-	Density, lb./ft.^{3}		Diffusivity, cm.^{2}/sec. x 10^{-2}		Smoke Penetration, %
	IPC	ACC	IPC	ACC	ACC
12-1	21.5	20.8	1.57	1.92	<0.001
17-4	21.8	-	2.45	2.59	<0.001
22-1	22.0	20.5	-	2.44	<0.001
26-2	21.2	19.5	2.43	2.70	<0.001

CHARCOAL CONTENT

Results of ashing tests on board samples have not been entirely satisfactory. The charcoal contents of samples determined by this method seem high, some of the results indicating retentions of greater than 100%. An ashing temperature of 1000°C. seemed to be necessary for the blank samples of charcoal while the board samples were ashed at 900°C. It was thought that this difference in ashing temperature might introduce some error. Several samples of charcoal and the board were ashed at temperatures ranging from 600 to 1000°C. The differences in ash contents in the range of 900 to 1000°C. were almost negligible. Further investigation will be necessary to determine the factors actually influencing these values.

D.O.P. SMOKE TESTS

Further changes have been made in an attempt to improve the operation of the smoke penetration tester. The smoke chamber and the amplifier were connected to a common ground, the light source in the smoke chamber was connected to a constant voltage transformer, and several of the electrical connections in the amplifier were resoldered. This seemed to reduce the fluctuation at the zero smoke setting somewhat. The thermoregulator controlling the temperature of the liquid D.O.P. in the smoke generator was readjusted from a control point of 174 to 172°C., which is the recommended setting. Some fluctuation of the temperature of the liquid D.O.P. beyond the controlling precision of the thermoregulator has been noted, perhaps the result of eddy currents developed in the liquid, which seem to affect the particle size of the smoke. A number of diffusion boards were tested for smoke penetration after the above adjustment had been made, and the operation of the unit was apparently satisfactory.

THE EFFECT OF PULP ON GAS LIFE

Report Four described the formation of boards made with samples of Minnesota and Ontario pulp to determine the effect of the small amount of wax rosin sizing present in the main portion of pulp received and to determine the effect of washing of this pulp with hot water. Gas life evaluations on these boards have been received and indicate (Table II) that the addition of the wax rosin size has caused some loss of CK life and that washing with hot water has improved the CK life to a level above that of the pulp without the size.

Some variation in individual test results is apparent. In addition, the estimated charcoal loading is not uniform from one series to another, primarily because of variations in board caliper and density although the charcoal content of 22-1 was low because of an inadvertent error in board manufacture which could not be corrected because of a shortage of this particular pulp. If it is assumed that gas life is a linear function of charcoal loading within the range considered, gas life values (adjusted to a standard loading of 5.0 g. per 100 $cm.^2$) for unsized, sized, and sized but washed pulps would be approximately 50, 25 and 55 minutes, increasing the apparent effect of the size and decreasing the effect of the washing. This washing does permit use of the available M & O pulp to produce boards of satisfactory gas life. The addition of alum to the sized pulp in the Minnesota and Ontario operation resulted in a slightly lower forming pH for the board made from this pulp as compared with the unsized pulp. The washing of the sized pulp with somewhat alkaline city water resulted in a forming pH for the washed pulp higher than either of the others. This difference in pH may or may not have had some influence on the gas life results.

One board (47-1) was formed with 25% ASC charcoal, using a special electrical-grade kraft pulp which had been produced commercially to have a low

TABLE II

THE EFFECT OF SIZING AND WASHING OF M & O
PULP ON GAS LIFE

Pulp Used	Forming pH	Board No.	Estimated Charcoal, g./100 cm.[2]	Gas Life, min. PS[a]	Gas Life, min. CK[b]
Without size	>7.9	22-1	4.1	33.3	43.5
					39.3
		Average	4.1	33	41
With size (as received)	7.3	17-2		36	21.1
				35.1	16.4
	7.3	17-4		35	27
				30	36.1
	7.3	17-5		36	30.1
		Average	5.3	34	26
With size, washed	8.6	26-1		43.2	65.2
					52.1
	8.6	26-2		47	94.4
					73
		Average	6.4	45	71

[a] Tested at 1 liter per minute, 50 mg. per liter, board as received but gas at 50% relative humidity.

[b] Tested at 1 liter per minute, 4 mg. per liter, board conditioned and tested at 80% relative humidity.

ash and low content of soluble material. This pulp may not be suitable for production of low-density boards but may be considered as a somewhat purer pulp for evaluation of gas life effects.

THE EFFECT OF pH ON GAS LIFE

Most commercial paper and board-forming operations are conducted with a pH in the general range of 4.5 to 5.5, utilizing alum as a component of the sizing process. Likewise, many wet-strength and other treatments are dependent upon the addition of alum or at least upon an acid pH for their effectiveness. Previous experience has implied that sizing agents, wet-strength agents, and other materials may be detrimental to the effectiveness of the activated charcoal, particularly against cyanogen chloride (CK). Because of the nature of the impregnating treatment used on the charcoal, it has been implied that operation on the alkaline side might be beneficial with respect to retaining maximum effectiveness of the charcoal. The effect of pH upon gas life is an important consideration because it could have a profound influence upon the selection of sizing materials which might be considered. Accordingly, several tests were initiated to determine whether pH in itself does affect gas life.

As part of a test of repulped newspaper as board furnish, boards were formed with repulped newspaper and 25% ASC Charcoal at several pH's as described in Report Four. Gas life evaluations on those boards have been received and show (Table III) a marked drop in cyanogen chloride (CK) gas life for the boards adjusted to pH 5.0 with either alum or sulfuric acid in comparison with the gas life of boards formed at higher pH levels. The first boards formed proved to be too dense and pressing conditions were reduced for those formed at the lower pH. As a result, there is a difference in density but this is believed to be of minor importance compared to the marked loss of CK life. At the higher pH, the repulped newspaper yields a board of adequate gas life indicating the suitability of this source of fiber from this standpoint.

TABLE III

THE EFFECT OF REPULPED NEWSPAPER AND OF pH ON GAS LIFE

Board No.	Charcoal-Water Contact Time, min.	Forming pH	Density, lb./ft.^{3}	Estimated Charcoal, g./100 cm.^{2}	Gas Life, min. PS	Gas Life, min. CK
33-3	39	>7.6	22.9	6.4	43	78
33-5	110	>7.6	24.8	6.4	50	60
37-2B	107	5.0[a]	19.1	6.4	42	9.0
37-3A	118	5.0[b]	19.2	5.4	45	8.4

[a] With sulfuric acid
[b] With alum

The PS life is believed to be dependent upon the adsorbing activity of the charcoal and the diffusion characteristics of the board, but the cyanogen chloride gas life is dependent also upon the presence and availability of the hexachromate materials incorporated into the ASC charcoal. These results indicate little or no effect of pH on PS life but a serious effect on the specific mechanism for protection against CK.

In order to study this effect in more detail, two series of boards were formed from Minnesota and Ontario pulp at various pH levels controlled by additions of alum. One series was formed from pulp which had been washed with hot water (approximately 90°C.), on a 40-mesh screen suspended in a steam-jacketed kettle, resulting in the loss of some of the fine material. The other series consisted of two boards formed from pulp which had been rinsed with cold water on the same screen in order to compensate for the fines loss in the hot water washing operation. These two series of boards should show the effects of pH on gas life and the combined effects of pH and washing on gas life. These boards were submitted for gas life tests on February 20; results of these tests were not available at the end of the reporting period. Data presently available for these boards are given in Table IV.

TABLE IV

BOARDS FORMED FROM M & O PULP, pH CONTROLLED WITH ALUM

25% Charcoal (Based on Ovendry Fiber) Incorporated into Pulp, Samples Dried at 105°C.

Sample 2256-	Charcoal-Water Contact Time, min.	Drying, hr.	Forming pH	Caliper, in.	Density, lb./ft.^{3}	CO_2 Diffusivity, cm.^{2}/sec. x 10^{-2}	Ash Content %	Charcoal Content, %
Boards Formed From Hot-Washed Pulp								
41-1	41	2.17	7.53	0.376	18.23	2.87	4.83	18.5
41-2	53	2.00	6.25	0.362	18.62	2.83	5.26	20.4
41-3	61	2.00	5.15	0.351	19.37	2.69	5.04	19.4
41-4	98	1.50	4.08	0.345	20.12	2.75	4.77	18.2
Boards Formed From Cold-Washed Pulp								
44-1	45	17.50	5.03	0.335	20.01	2.95	--	--
44-2	53	15.25	4.10	0.335	19.50	2.75	--	--

DEVELOPMENT OF SIZING AND WET STRENGTH

Although wet strength as such, (that is the retention of strength even though saturated with water), may be desirable, good water repellency may be adequate for field use and emphasis will be placed first on sizing agents. The indication that low pH levels detrimentally affect the function of the ASC charcoal seems to preclude any sizing operations under acid conditions with charcoal present. Possibly a two-stage operation (sizing under acid conditions followed by washing to remove excess alum and an increase in pH to the alkaline side before the incorporation of charcoal and forming) could result in effective sizing without any great loss in gas life but would introduce processing difficulties. The use of sizing agents effective under alkaline conditions seems to be the more promising approach.

Inquiries were directed to American Cyanamid Company and to Hercules Powder Company for suggestions and suitable materials. From the former, samples of dark rosin size, Alwax 253A (a wax emulsion) and of Cyron Size were obtained. Of these, only Cyron seems suitable for use at an alkaline condition. It is a thermoplastic, water-dispersible synthetic wax, being described chemically as a salt of a hydrophobic, polyfunctional amine. As received, the material is 100% active and can be dissolved in water at 5% concentration.

Hercules Powder Company submitted samples of Aquapel 360 emulsion and of Aquapel 486; in order to improve performance of the Aquapel they also furnished samples of their Kymene 557 and of Cato 8 Starch (a cationic starch). They indicated that the conditions of use we described (groundwood insulation board) are not conducive to good results with Aquapel. Incorporation of some kraft pulp and additional drying at 250°F. for 15 to 20 minutes after the board is ovendry were suggested. Aquapel 360 Emulsion is used as a surface application, or in the fiber furnish with cationic starch or with Kymene 557. Aquapel 486 is an experimental material developed for stock addition; it consists of Aquapel 364 deposited on an equal weight of fine silica.

Because of previous experience with Aquapel, first trials were made with it. Boards were formed from washed Minnesota and Ontario pulp incorporating 25% charcoal, with additions of Aquapel 486 and with additions of Aquapel 486 and Cato 8. The Aquapel additions were varied from 0.5 to 0.1% active material, and the Cato 8 additions varied from 0.5 to 0.25%. These additions were based on ovendry fiber. All of the samples were oven dried at 105°C. and sections of each sample were placed in an oven at 250°F. for one hour to promote further curing. These samples will be tested for water absorption.

FUNGICIDES

Discussions with other members of the Institute staff indicated that the most promising agents for imparting mildew resistance would be sodium pentachlorophenate, copper pentachlorophenate, bis (tri-n-butyltin) oxide (TBTO), and copper-8-quinolinolate.

A test procedure for screening various fungicides has been set up. It involves direct inoculation of a nonsterile specimen with Aspergillus niger and Chaetomium globosum in accordance with the procedure outlined in the Federal Specification Number CCC-T-191b. We were informed that this Federal Specification is the basis for such testing at the Army Chemical Center.

Samples of Dowicide G (sodium pentachlorophenate) and TBTO were available. Two series of boards were formed from washed Minnesota and Ontario pulp with additions of these agents (Table V). The Dowicide G additions were made at two levels--4 and 1% based on ovendry fiber--to 4% slurries of pulp before the charcoal additions; in order to precipitate the pentachlorophenol, it was necessary to add the

TABLE V

INCORPORATION OF FUNGICIDES INTO DIFFUSION BOARD

Boards Formed From Washed M & O Pulp, with 25% Charcoal Additions[a]

Sample 2256-	Fungicide Material	% Added[a]	Charcoal-Water Contact Time, min.	Drying at 105°C., hr.	Forming pH	Caliper, in.	Density, lb./ft.^{3}
49-1	Dowicide G	4.0	28	2.5	5.52	0.350	20.18
49-3	Dowicide G	4.0	25	2.5	4.98	0.352	20.24
49-2	Dowicide G	1.0	24	3.0	5.16	0.338	20.57
49-4	Dowicide G	1.0	24	17.5	5.27	0.348	20.36
51-1	TBTO	1.0	23	2.0	8.26	0.348	20.44
51-2	TBTO	1.0	29	2.0	--	0.342	20.00
51-3	TBTO	0.1	23	2.0	8.25	0.337	20.32
51-4	TBTO	0.1	24	1.5	--	0.343	20.09

[a]Additions based on ovendry fiber.

Dowicide in a 5% alkaline solution and lower the pH with alum after the addition. The TBTO is not water soluble; consequently, it was added to the pulp slurry in a 5% acetone solution with the thought that the resulting three-component solution would yield a precipitate of TBTO. Two addition levels of the TBTO were used, 1 and 0.1% based on ovendry fiber. The acetone solution was added to the pulp at 4% consistency, under alkaline conditions and before the addition of the charcoal. At the end of this reporting period, samples had not yet been tested for mildew resistance, and testing of samples sent to the Army Chemical Center for gas life tests was not complete.

Mr. Seymour Goldfarb of the Scientific Oil Compounding Company, Inc. visited the Institute and discussed the aspects of imparting mildew resistance to the diffusion board. He stated that his company would be glad to supply us with samples of copper-8-quinolinolate and suggested that we first determine the conditions under which we would size the board and add the fungicide; then he could supply us with a sample or samples of their Cunolate fungicide especially formulated for these conditions. In this country copper-8-quinolinolate is generally used for surface applications due to its relative expense; however, in Europe it is commonly used as a beater additive.

Sizing conditions, being more critical in a number of aspects, will no doubt dictate the conditions under which a fungicidal material will have to be used in producing a sized, mildew-resistant board. Possibly one or more of the above-mentioned materials could be used under a given pH condition. Thus, the incorporation of fungicides can be relegated to a position of secondary importance to the investigation of sizing.

OTHER CONTACTS AND DISCUSSIONS

FOREST PRODUCTS LABORATORY

After some delays, Messrs. Jones, Leporte and Howells of the Institute staff and Mr. Grover Condon, Contract Project Officer, went to Madison, Wisconsin on February 1 to discuss the previous work on diffusion board material with personnel of the Forest Products Laboratory. The principal contact at the Forest Products Laboratory was Dr. Harold Tarkow, one of the people who had worked on the development of the diffusion board. Also taking part in discussions was Mr. S. L. Schwartz of the Forest Products Laboratory. The general development of the diffusion board material was reviewed, but Dr. Tarkow had comparatively little to add to what had been covered in the reports.

In connection with dry forming, Dr. Tarkow reiterated his feeling that this is still a possibility but that during their development of the board wet forming had seemed much more attractive when they found that it could be used without complete loss of effectiveness of the ASC charcoal. Apparently, the original project was conducted under a considerable degree of urgency and they attempted to develop a product quickly rather than to survey what might be the best of several alternatives.

In a discussion of the possible effects on the impregnated charcoal and methods for studying these variables, Dr. Tarkow suggested study of the kinetics of the reduction of hexavalent chromium. For example, he thought that a test-tube study of hexavalent chromium plus plain sugar might lend itself to optical evaluation as a screening test for the effect of pH or other variables. He also referred to the attempts to develop a nondestructive magnetic method for determining hexavalent vs. trivalent chromium.

It was thought at the Forest Products Laboratory that it was necessary to remove the "skin" on all boards. Sanding was adopted as a standard procedure after it was found necessary on some boards; consequently, it was never ascertained that sanding was necessary on all boards. Dr. Tarkow commented that most of their boards appeared to be glazed. Possible reasons for this glaze might be the difference in fiber orientation, difference in concentration of fines, and a migration of soluble materials to the surface.

Mr. Schwartz expressed his belief that Aquapel will not work on groundwood insulation board. (Mr. Condon stated that he had been able to produce some sizing effects with Aquapel and groundwood insulation board at the Army Chemical Center.) As to pertinent test methods for insulation board, Mr. Schwartz commented that he did not know of any better methods than the tests outlined in the Federal Specification for Insulating Fiber Board (LLL-F-321b). Evidently no work was done at the Forest Products Laboratory on sizing or additives, since at that time water repellency and/or wet strength were not considered to be necessary or desirable properties of the diffusion board.

CONTRACT PROJECT OFFICER

Following the discussions in Madison, Mr. Condon visited the Institute on February 2, 1961. In addition to results on gas life testing which he brought with him, he also informed us of some tests made at the Army Chemical Center on the effect of different pulps on gas life. Requests had been addressed last summer to a number of companies for a variety of pulp samples. Samples were received from the Wood Conversion Company, Armstrong Cork Company, and Minnesota and Ontario Paper Company, and were made into boards with 25% charcoal added but with no other additives. Mr. Condon determined charcoal retention by comparative weighings of the pulp and charcoal that went into the board and of the boards produced. From these figures he calculated the loading in grams per hundred square centimeters of board. Gas lives were determined for these samples. These results are summarized in Table VI along with gas life calculated to a standard five-gram loading and show a marked effect of different pulps. Mr. Condon approved the idea of contacting these companies for further information on these pulps to assist in the interpretation of these data, and this is being done.

TABLE VI

THE EFFECT OF CERTAIN PULPS ON GAS LIFE

Source	Type	Charcoal Loading, g./100 cm.^{2}	CK Life, min. As Received	CK Life, min. Calculated to 5 g. Loading
Wood Conversion Company	Aspen defibrator fiber	4.64	24	26
	Aspen defibrator fiber, chemically treated aspen slow stock	4.82	33	34
	No. 3 Machine stock without size	4.98	48	48
Armstrong Cork Company	Pine (grinder)	5.44	29	27
	Willow (grinder)	5.30	67	63
Minnesota and Ontario Paper Company	Fine stock	5.19	52	50
	Asplund	4.88	50	51
	Paper mill groundwood	5.15	63	61

ARMSTRONG CORK COMPANY

As a result of the difference in gas life shown by the pine and willow samples received from Armstrong Cork Company, an inquiry was sent to this company for further information of the history of these samples and on the possibility of obtaining samples of these pulps for laboratory evaluation and possible use in pilot plant or commercial runs. In his letter of February 14, Mr. W. L. Scott, (Manager of Fiberboard Research at the Research and Development Center of Armstrong Cork Company in Lancaster, Pennsylvania,) replied that both of these pulps would be available commercially from the Macon, Georgia plant and that they would be happy to send us free-of-charge limited quantities for laboratory work. Both pulps are used in the production of insulating board and therefore might be considered suitable for commercial production, but Mr. Scott thought that the weight per cubic foot of the willow pulp might make it difficult to produce a board of 21 lb. per cubic foot density at normal production rates. Apparently, these pulp samples were taken from the grinders with no additive other than a small amount of Dowicide G. In a subsequent letter to Mr. Scott, we requested samples of the willow pulp and also additional information on the services of their pilot plant which he had indicated had been offered for this program in the past.

WOOD CONVERSION COMPANY

In reply to an inquiry to Wood Conversion Company on the history of the pulps furnished by them to the Army Chemical Center, Dr. R. R. Sullivan visited the Institute for a full discussion of the whole program. The pulps tested by the Army Chemical Center (see Table VI above) were all made from undebarked aspenwood, without special washing and without the addition of any size or alum. Further discussion developed the following relationship between these three pulps. Three different pulps are involved; these may be described as follows:

Pulp A - Aspen Defibrator fiber prepared on the defibrator and refined without any chemical action.

Pulp B - Aspen chips were mixed half and half with water and passed through a digester with 2-1/4% sodium sulfite, the pressure due to temperature being 141 lb. per square inch and the transit time 8 minutes. This was then refined in a No. 410 Bauer to 400 to 500 cc. mill freeness.

Pulp C - This is the same pulp as Pulp B except that it has not been Bauer refined to as great an extent.

The three samples tested for gas life were blends of these various pulps. The "Aspen Defibrator fiber" is Pulp A and showed the poorest gas life. The pulp identified as "Aspen Defibrator fiber, chemically treated Aspen slow stock," is a 50-50 blend of Pulp A and Pulp B, which was mixed by the Army Chemical Center. This had intermediate gas life, slightly better than the Aspen Defibrator fiber alone, implying that the chemically treated stock would have a better gas life if used alone. The "No. 3 Machine stock," which had the best gas life, is composed of 20 parts of Pulp A, 10 parts of Pulp B, and 55 parts of Pulp C, or, disregarding the action of refining, a mixture of 20 parts of the Aspen Defibrator fiber and 65 parts of the chemically treated pulp. This is further indication that the chemically treated pulp is better from the standpoint of gas life. Dr. Sullivan agreed to send us samples of all three components of this stock for further testing.

During Dr. Sullivan's visit, we also discussed a number of other aspects of this board program. Wood Conversion Company has an 8-foot forming machine available for research and development operations and they would be willing to co-operate with us on trials on this machine or on a commercial run; however, the 8-foot machine does not have drying facilities. In discussing methods of evaluating strength characteristics of a product of this type, Dr. Sullivan mentioned that a new Federal Specification for Insulating Board has been released recently (LLL-I-535, copy of which has been ordered). For comparative evaluation of products that might be suitable for field use, he suggested half-inch sheathing as an example of a minimum product. This material could be available (without the activated charcoal) in commercial quantities for tests of strength, water repellency, and other field characteristics and could also be tested by our methods for a base line of comparison.

The possibility of dry forming was also discussed briefly. Most dry-forming operations are conducted on hardboard where a comparatively small amount of resin binder (probably 3/4 of one per cent) is adequate. As the density is reduced, larger quantities of binder are required. By contrast, the Wood Conversion Company is producing a low-density blanket material using starch as a binder. Dr. Sullivan was skeptical of the possibility of making board of the density required in this project by dry forming, since this density would fall between their type of operation and the conventional hardboard. Other problems might be involved in handling the charcoal in dry form and in getting retention of the charcoal on the fibers. They do have several laboratory forming units which might be used for this purpose if it appears desirable to do so. However, their commercial equipment would not have adequate pressing for reaching the density under consideration.

The mineral fiberboard produced by Wood Conversion Company was discussed briefly. It is used for ceiling tile and could furnish an interesting approach to the development of a different diffusion board material. The use of mineral fiber in place of wood fiber would result in a board with different behavior with respect to charcoal poisoning, fireproofness, and sizing. A binder would probably be required, but this might be modified to fit this particular requirement. This board would have poor impact resistance and would not stand handling as well as wood fiberboards. However, it is also probable that it would be more permeable than the wood fiberboard at a given density, which raises the possibility of going to 1/2-inch construction instead of 1/4 inch. Special techniques are required for handling this fiber and Dr. Sullivan will discuss with other Wood Conversion Company personnel the question of furnishing us a small quantity of mineral fiber for laboratory investigation, along with the technology they feel is necessary in order for us to make a valid evaluation.

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