PLAINTIFF'S EXHIBIT

DOW-1109

NINTH PROGRESS REPORT

ON

STUDIES OF KAYLO

TO

OWENS-ILLINOIS GLASS COMPANY

C-5733A

May 16, 1947

01 063 0501

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HLK:pg

May 16, 1947

Owens-Illinois Glass Co.
Toledo
Ohio

Attention: Mr. U. E. Bowes

Gentlemen: C-57334

We transmit herewith our NINTH PROGRESS REPORT ON STUDIES OF KAYLO. This report covers the first phase of our investigation on determining the possibility of replacing part or all of the asbestos in Kaylo by paper pulp.

While our previous investigations on the use of paper pulp were exploratory in nature and concentrated on the replacement of "spiculated" asbestos, our present investigation takes into account the present plant practice and emphasizes replacement of asbestos in a manner which would necessitate no change in plant procedure and as little change in batch formulation as possible.

At this time it can be reported that from a strength point of view Kraft pulp can be used as a satisfactory substitute for Chrysotile asbestos, if some

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ball clay is included in the batch formulation. Furthermore, Gum Karaya has been found helpful in obtaining improved results with paper pulps.

As a result of our present study we have improved our understanding of the action of clay materials in Kaylo.

Future work will comprise study of the influence of Kraft pulp on physical properties other than strength such as heat conductivity, thermal stability, and fire tests. It is further planned to study various other available paper and wood pulps as possible substitutes for asbestos.

Respectfully submitted,

Arthur D Little, Inc.

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I. INTRODUCTION

In previous work as summarized in our EIGHTH PROGRESS REPORT ON THE FUNDAMENTAL STUDY OF MICROCRITE, of March 27, 1946, we established the fact that paper pulp can be used successfully as a substitute for "spiculated" asbestos. The present asbestos shortage greatly increased the interest in this possibility from a practical point of view. Accordingly, the present study was initiated in order to investigate the possibilities of partial or total substitution of asbestos by paper pulp from a technological and economical point of view.

Since from a merely sales point of view there may be a resistance towards the inclusion of an organic material in Kayle, it is assumed that the use of paper pulp is contemplated as a substitute only when and if the amount of suitable asbestos grades available are insufficient. Accordingly, it was endeavored to develop formulae for the incorporation of paper pulp which will not necessitate any change of the present plant procedure, as well as the least possible change in slurry characteristics and batch formulation.

It is believed that we have achieved this aim for Kraft pulp as a substitution material, even though we are fully aware of the fact that the final test will reside in pilot-plant tests.

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In our investigations we have made some interesting observations with respect to the action of clays in Kaylo and we feel, that further study of these phenomena may show up that clays may serve as a suitable material to balance out property variations due to changes in the types and/or amounts of certain raw materials used, such as bestos, diatomaceous earth and quarts.

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XI. SUMMARY AND CONCLUSIONS

1. Kraft pulp can be used as a partial or total replacement for asbestos when:
   a. introducing clay into the batch,
   b. if hinging is not important,
   c. whereby addition of Gum Karaya has proven to be helpful.
2. A brief economic survey of the availability of cellulosic pulp materials is recommended.
3. The significance of clay addition is discussed and it is felt that clay may help:
   a. in reducing the asbestos amount in all asbestos mixtures,
   b. in adjusting variations in raw materials.
4. A proposed future program for this project is outlined.

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XXI. SUBSTITUTION OF ASBESTOS BY PAPER PULP

1. MECHANIC ASPECTS

In our report of November 26, 1946 on "Availability of Asbestos" the market situation of asbestos has been discussed in some detail. While it is stated there that the shortage of spinning-grade asbestos may not be as severe as of some other grades, it was still felt that the general situation will be tight for years to come. Accordingly, the recommendations of this earlier report emphasized the desirability of a search for substitution products.

Our previous and present findings strongly indicate that certain paper pulps may furnish a suitable substitution material for part or all the asbestos. It is realized that paper stock of all kinds is not too readily available. However, the tonnage necessary for partial or total replacement of asbestos in Kaylo is a much smaller percentage of the paper trade, so that local conditions and strong bidding could create a much more favorable position than in the asbestos market.

Still it is strongly recommended that a brief economic survey of the availability of cellulosic pulp materials suitable for our purposes be undertaken as soon as possible, especially with respect to new Kraft clippings.

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Kraft prices, while on a high level at present, compare favorably with asbestos prices and new Kraft clippings, as used in our present experiments, are quoted at only $45.00 per ton. Bailed, old newsprint is quoted at $20.00 and wood pulps anywhere from $60.00 to $100.00 per ton.

2. THE FUNCTION OF ASBESTOS

While originally a strong emphasis was put on the suspending properties of asbestos, present practise has moved away from this concept and primarily considers its functions as a reinforcing agent.

By and large it is now generally accepted that "spiculated" asbestos is not necessary for the successful preparation of Kayle and asbestos as used in present batch formulation can be hardly designated as "spiculated." A sample of asbestos slurry provided by Berlin had a freeness of fifty, while "spiculated" asbestos would correspond to a freeness of about 70 or more. The degree of opening up presently used provides satisfactory strength and bonding properties.

When the concept of asbestos as a suspending agent still was emphasized, the "gelatinous" properties of "spiculated" Chrysotile were frequently thought of as a contributing factor. However, even from this point of view it was quite conclusively found that blue African

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and Amosite asbestos which do not show any "gelatinous" properties are just as good, if not better than those of Chrysotile. They are possibly somewhat inferior with respect to hinging (see THIRD PROGRESS REPORT ON INVESTIGATION OF EFFECTS OF ADDITIONS OF ASBESTOS TO MICROPORITE, August 16, 1943, C-57316). This has been somewhat borne out by actual plant experience with Amosite in the Berlin pilot plant.

Since, as we understand, 10 lbs./cu.ft. products for boiler lagging and pipe covers will be of secondary importance in the planned large-scale production, while 20 lbs./cu.ft. door cores and roof slabs will be of primary importance, it is believed that hinging properties will be of less interest than in the earlier investigations. Furthermore, reinforcement and suspending power are probably less critical in the 20 lb. product.

Accordingly, it is believed that it should be quite possible to use various grades of asbestos interchangeably without materially affecting the quality of production. As will be discussed later, appropriate utilization of minor amounts of clay might prove helpful in adjusting the batch properties in changing over from one type of asbestos to another.

Minor additions of clay might also permit a reduction in the total amount of asbestos used and thus help to conserve stocks.

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3. SUBSTITUTION OF ASBESTOS BY CELLULOSE PULPS

As will be discussed in detail in the following section, the first phase of our investigation has proven quite conclusively that from a strength point of view asbestos can be successfully replaced by paper pulp, whereby our experiments thus far were limited to Kraft pulp as made from new Kraft clippings.

In preparing a batch of similar consistency as now used in actual production and in obtaining satisfactory strength:

(1) the use of about 10% clay addition (whereby the SiO_2 of the clay is substituted for SiO_2 of the basic batch) was found decisive for successful total substitution of asbestos by paper pulp and,

(2) the addition of Gum Karaya for dispersion of the fiber was found to be quite helpful and is included in our preferred batch formulation.

Batches made with paper or even paper and asbestos mixtures are not satisfactory with respect to hinging however.

Typical batch compositions are given in Table VI under 3a and 3b.

Our present experience appears to indicate that for partial replacement of asbestos the amount of clay to be added may be a function of the degree of reduction in asbestos addition.

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In preparing paper pulps we used a paper beater, but it is assumed that any other method of pulping, whether dry or wet, could be used with equal success.

4. FUTURE PROGRAM

Now that the usefulness of paper pulp as an asbestos substitute has been established and in view of our other observations, we recommend continuation of our program as follows:

(a) Preparation of samples of our best present formula and of standard composition for comparative tests with respect to the following properties:
  (1) fire resistance
  (2) strength vs. heat treatment up to 650°C.
  (3) strength vs. humidity.

(b) Addition of clay vs. varying substitution of asbestos in the base formula.

(c) Exploration of other cellulose pulps in place of Kraft:
  (1) Newsprint
  (2) Wood pulp
  (3) Other available paper pulps.

(d) Reduction of asbestos in present formulae without substitution vs. addition of clay.

(e) Consideration of paper pulping machines other than in the Valley paper beater.

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IV. EXPERIMENTAL PART

1. PREPARATION OF SAMPLES

In the preparation of samples it was endeavored to duplicate as much as possible plant conditions at Berlin.

The basic batch formula is given in Table VI under 1. and correspond to the basic formula as used in Berlin. Slaked lime, as used in Berlin, however, was replaced by Warner lime hydrate, since slaking is believed to be undesirable for laboratory purposes both with respect to handling and reproducibility of results.

At the recommendation of Mr. Shuman a box-type mixer was used as it was believed to reproduce mixing conditions at Berlin better than the Simpson mixer previously used in this laboratory. The box-type mixer is shown in Plate I. Mixing time was one half hour.

It was decided to omit the prehardening step in our experiments, since this is believed to not seriously change the validity of experiments and would introduce another factor complicating reproducibility of results.

The indurating cycle was adjusted according to recommendations by Berlin and the entire cycle, including the blow off rate, is regulated by a program controller and the temperature cycle was recorded as shown in a

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typical record chart in Plate II. The autoclave, boiler, program controller, and temperature recorder are shown in Plate III.

The samples were dried as shown in the various tables and conditioned in the laboratory for 24 hours before testing.

The asbestos and paper were beaten on a standard paper beater and the degree of beating checked by the standard freeness test.

2. EVALUATION OF DATA

Close approximation of plant procedure on a laboratory scale introduces considerable difficulties with respect to reproducibility of data. The short mixing time in particular appears to be objectionable in this respect.

Nevertheless, it was decided to adhere to the above outlined procedure rather than to adopt the methods used in the Toledo "Materials Laboratory," since it was believed that in this manner results were more directly applicable to plant procedure.

Ten pound density was chosen for most of our experiments, since it was assumed that differences between paper pulps and asbestos would become more noticeable in the lighter product.

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In order to obviate some of the day to day deviations comparison samples of the standard plant composition were included in all runs, unless comparative values of variations in paper pulp batches were to be investigated only.

In evaluating results average trends were considered rather than comparison of individual batches. In this manner it is felt that, in spite of considerable variation in results from run to run, the findings are quite reliably established.

All strength values were reduced to a theoretical density of 10 lbs/cu.ft. by assuming straight line relationship between strength and density, which appears to be satisfactory for comparison purposes, since densities of the samples varied between 11 lbs./cu.ft. and 12.5 lbs./cu.ft. only.

3. FIRST SERIES, ADDITION OF KRAFT

A freeness of 80 was chosen as the standard freeness for Kraft paper pulp, even though 50 would probably be sufficient. Since the raw material used is new Kraft clippings, it was thought that a higher freeness would warrant more uniformity. If it should become desirable, however, tests with 50 freeness pulps will be carried out.

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Table I summarizes results in this series of experiments. On the average the Kraft mixtures (12% Kraft) were 18% lower in strength than the asbestos samples.

Previous experiments had indicated that Kraft in additions of not more than 4% is most beneficial for reinforcing purposes. Such mixtures, however, are too thin for plant practice. Samples A-41 to A-45 on Table I appear to indicate that 10 to 12% Kraft gives better strength than either 8 or 14%. Since, considering the difference in specific gravity, 12% Kraft pulp should have about the same volume as 20% asbestos, and since 12% Kraft gives about the same consistency as 20% asbestos, 12% Kraft addition was chosen as the standard for all our comparison tests.

The various Kraft asbestos mixtures shown in the Table appear to indicate that the mixtures result in as low values as the all-Kraft pulp samples.

Improved mixing in the Simpson mixer seems to benefit asbestos more than paper pulp (possibly because of the greater freeness chosen), while longer autoclaving apparently benefited them equally well. However, the results shown in Table II, make it apparent that the induration time influence rather insignificant and does not affect the relative results of this investigation.

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In connection with this series the effects of Kerosene and Foamex as dispersing agents were tried. While there was some indication that these additions have a slightly beneficial effect, results were not significant enough to warrant further investigation.

4. SECOND SERIES, INFLUENCE OF DRYING TEMPERATURE

The inconsistency of results, and the known properties of cellulosic materials suggested a brief investigation of the influence of drying procedure as summarized in Table II.

The variations in drying procedure did not show any significant results for the Kraft samples and the average difference between asbestos and Kraft samples was even greater than in the first series.

5. THIRD SERIES, MISCELLANEOUS ADDITIONS

Observations of the batch mixtures appeared to indicate that paper pulp has a tendency to agglomerate during mixing in the concentrations used in our batches. The relatively good results previously obtained with batches containing 4% Kraft where this effect would be minimized appear to bear out this conclusion.

Various unsuccessful approaches to obviate this are summarized in Table III.

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6. FOURTH SERIES, ADDITION OF GUM KARAYA

Experience in the manufacture of stencil sheets has shown that deacetylated Gum Karaya is outstanding in the dispersion of long-fiber paper pulps. Accordingly, it was thought that it may be beneficial in a similar manner in the preparation of cellulosic pulp Mylo batches.

The use of deacetylated Gum Karaya is patented and the patents are held by the John A. Manning Co., which had been assisted in this development by our Company. It is assumed that, if desirable, satisfactory license arrangements could be obtained. The price of Gum Karaya is from about 30 to 50¢ per pound. Two percent deacetylated Gum Karaya was used in most of our experiments; possibly higher additions may bring about some improvement.

The results of this series are summarized in Table IV. Deacetylated Gum Karaya obviously bring about some improvement and the average figures are given in the last lines of the Table. Especially comparison with the averages from the second and fourth series point out the marked improvement obtained. Nevertheless, the results are still consistently lower than those obtained with asbestos.

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It should be noted, however, that the two batches using mixtures of 6% asbestos plus 6% Kraft (A-130, A-145) give equally as good results as 20% asbestos alone.

7. FIFTH SERIES, ADDITION OF DIXIE CLAY

Previous experience with the beneficial effect of clay additions suggested the use of clay for the improvement of cellulosic pulp batches. The results as summarized in Table V show the highly beneficial effect of this addition. The batch compositions used in this series are given in Table VI, 3.

Samples A-134 through A-137 illustrate a phenomenon, observed several times previously, which is not quite understood and could not be further investigated within the scope of this project. Certain batches seem to improve markedly on redrying of the samples to 120°C. for about one half to one hour.

While this series clearly demonstrates the beneficial action of clay on Kraft batches, it is incomplete in many respects. It fails to show whether Gum Karaya is beneficial in conjunction with clay. It also does not show sufficient variations in clay content and base formula variation, both with respect to all-Kraft and to mixed Kraft-asbestos batches.

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V. THE CLAY PROBLEM

That clay additions may have a beneficial effect on Kaylo has been observed from time to time, both in Berlin and in our laboratories.

In our EIGHTH PROGRESS REPORT (page [illegible]) it was stated that the amount of clay which can be introduced to advantage appears to be dependent on the type of asbestos used and on the amount of asbestos dust introduced by it. We received information from Berlin that clay addition was beneficial with certain shipments of Dicalite. Five percent clay was used as a standard addition in most of our previous cellulosic pulp batches so that no comparison data were available. Aluminum hydroxide, clay, and Portland cement were found beneficial in previous experiments in our laboratories. Most of this previous work was made with Celite, which is purer than Dicalite, and usually with asbestos additions of less than 15%.

In twenty pound materials we have been able to introduce considerably higher amounts of clay obtaining very strong bodies without excessive shrinkage.

The present investigation again highlights the fact that clay can be highly beneficial under certain circumstances. The scant results seem to indicate (see Table V in conjunction with Table VI), when comparing

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batch A-133 and A-135 with batch A-134, that introduction of clay by substituting its silica content for silica of the base composition is preferable to substituting total clay for silica.

The evidence thus far collected seems to indicate that asbestos and clay (or aluminum hydroxide?) have similar action on the calsipore formation. Possibly we deal with absorption reactions which might have a retarding effect on the lime. In any case, the effect of aluminum compounds and its possible similarity to the chemico-physical action of asbestos appear to be of sufficient importance to warrant more systematic exploration.

In this respect cellulosic pulp batches lend themselves well for research, since the possible influence of asbestos, and variations thereof from batch to batch can be eliminated.

The following variables appear to be of immediate interest:

(a) Variation of clay content with a given C/M ratio (M = silica raw material + SiO_2 in clay).

(b) Variation of C/M ratio for a given clay content.

(c) Influence of type of aluminous raw material, such as hydrated alumina, Kaolin, different types of ball clays.

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In addition thereto, the influence of asbestos from a chemical point of view should be studied by using asbestos dust in a similar manner as outlined for clay under (a) and (b) above.

From a practical point of view the following interesting implications can be foreseen:

(1) Asbestos content could be radically reduced when introducing clay in a balanced manner.

(2) Clay could be used as a compensating factor for lot to lot variations of asbestos and diatomaceous earth shipments.

(3) Clay might allow reduction of diatomaceous earth content.

(4) Clay could influence the chemical stability of Kayle.

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TABLE I *

First Series

Kraft Pulp Addition, Dried at 160°C.

Sample	Lbs./Sq.in.
Average 20% Asbestos	64
Average 12% Kraft	56
Variation of Kraft Addition	
A-41 6% Kraft	40
A-42 8% "	33
A-43 10% "	52
A-44 12% "	52
A-45 14% "	49
Kraft Asbestos Mixtures	
A-50 20% Asbestos	70
A-44 4% Kraft + 10% Asbestos	64
A-47 10% Kraft + 8% Asbestos	54
A-46 8% Kraft + 4% Asbestos	47
A-66** 20% Asbestos	66
A-70 12% Kraft	48
A-66 6% Kraft beaten with 6% asbestos to 65 freeness	53
A-67 6% Kraft + 6% Asbestos	50

Mixing Procedure and Autoclaving

	5 Hours Autoclave		7 Hours Autoclave	
	Simpson	Box	Simpson	Box
20% Asbestos	65	58	77	65
12% Kraft	48	46	53	47
12% Kraft		48*		

*(twofold mixing time)

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* Basic batch compositions - see Table VI.

** In this and the following tables separate runs are separated by a solid line.

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TABLE II

Second Series

Influence of Drying Temperature

Sample No.	Composition	Heat Treatment	Lbs./ sq. in.	Aver.
A-85-A	20% Asbestos	105°C.	63	64
A-86-A	" "	"	67	
A-85-B	" "	150°C.	49	
A-86-B	" "	"	47	
A-80-A	12½ Kraft	105°C.	45	50
A-81-A	" "	"	47	
A-80-B	" "	150°C.	52	
A-81-B	" "	"	52	
A-83-B	" "	"	51	
A-83-C	" "	105°C. up to 150°C.	53	
A-86-A*	20% Asbestos	160°C.	75	70
A-87-A*	" "	"	65	
A-86-B*	" "	room temp. to 160°C.	50	
A-87-B*	" "	" " " "	54	
A-88-A*	12½ Kraft	160°C.	58	53
A-89-A*	" "	"	56	
A-90-A*	" "	"	52	
A-88-B*	" "	room temp. to 160°C.	52	
A-89-B*	" "	" " " "	58	
A-90-B*	" "	" " " "	50	
A-107	20% Asbestos	180°C.	86	
A-108	12½ Kraft	"	44	
A-96-D	12½ Kraft	160°C. to 10% moisture, conditioned.	44	
A-97-A	" "	160°C. to 10% moisture, conditioned.	49	
A-96-B	" "	160°C., tested immediately	40	
A-97-B	" "	160°C., tested immediately	47	
A-100-B	" "	160°C., tested immediately	58	
A-100-C	" "	160°C.-105°C., tested immediately	52	
A-98-C	" "	160°C.-105°C., tested immediately	61	
A-99-C	" "	160°C.-105°C., tested immediately	48	
A-98-D	" "	Like C, but conditioned	43	
A-99-D	" "	" " " "	39	

* 7 hours induration

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TABLE III

Third Series

Miscellaneous Additions, Dried at 120°C.

Sample	Composition	Lbs./ sq.in.
A-110	80% Asbestos	79
A-111	12% Kraft impressed Jasper X	53
A-112	" " " " "	59
A-113	20% Asbestos	72
A-113	12% Kraft + Methocel for dispersion	46
A-115	" " " " "	52
A-116	12% Kraft .54 C/K ratio	52
A-117	12% Kraft .66 C/K ratio	52
A-119	20% Asbestos	64
A-121	12% Kraft	57
A-120	12% Kraft beaten with lime	52
A-122	12% Kraft beaten to 50 freeness + Methocel	54
A-118	12% Kraft + oxalic acid	56

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TABLE IV

Fourth Series

Gum Karaya Addition, Dried at 120°C.

Sample	Composition	Lbs./ sq.in.
A-110	20% Asbestos	[illegible]
A-112-A	12% Kraft + Gum Karaya	[illegible]
A-123	20% Asbestos	58
A-125	12% Kraft + Gum Karaya	55
A-126	12% Kraft + Gum Karaya + Kerosene	62
A-128	20% Asbestos	70
A-129	12% Kraft + Gum Karaya	62
A-130	6% Asbestos + 6% Kraft + Gum Karaya	70
(A-131	10% Kraft + Gum Karaya, 20 lbs./ sq.ft.	170)
A-135-A	20% Asbestos	61
A-133-A	12% Kraft + Gum Karaya	56
A-134-A	12% Kraft + Gum Karaya + Kerosene	46
A-136-A	12% Kraft	48
A-141	20% Asbestos	74
A-144	12% Kraft + Gum Karaya + Kerosene	64
A-145	6% Asbestos + 6% Kraft + Gum Karaya	79

			Second and Fourth Series
Average	20% Asbestos	65	66
Average	12% Kraft	53	51
Difference		-18%	-23%
Average	20% Asbestos	67	
Average	12% Kraft + Gum Karaya	59	
Difference		-11%	

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TABLE V

Fifth Series

Addition of Dixie Clay, Dried at 120°C.

Sample	Composition	Lbs./ Sq.in.	Samples Repiped
A-110	20% Asbestos	79	
A-108	12% Kraft, .6 C/K ratio, 8% clay	79	
A-109	12% Kraft, .6 C/K ratio, 8% clay	67	
A-123	20% Asbestos	58	
A-124	20% Asbestos, .6 C/K ratio, 8% clay	58	
A-127	12% Kraft, .6 C/K ratio, 8% clay	62	
A-137	20% Asbestos	77	92
A-133	12% Kraft, .6 C/K ratio, 8% clay, Gum Karaya	73	74
A-134	12% Kraft, .67 C/K ratio, 10% clay, Gum Karaya	62	82
A-135	12% Kraft, .6 C/K ratio, 10% clay, Gum Karaya	84	97
A-136	12% Kraft, .8 C/K ratio, 25% clay, Gum Karaya	51	48
A-141	20% Asbestos	74	
A-142	12% Kraft, .6 C/K ratio, 8% clay, Gum Karaya	84	
A-144	12% Kraft, Gum Karaya	64	
A-145	6% Asbestos + 6% Kraft, Gum Karaya	79	
A-146	6% Asbestos, .6 C/K ratio, 8% clay, Gum Karaya	81	
Average	20% Asbestos	72	
Average	12% Kraft, .6 C/K ratio, 8% clay	73	

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TABLE VI

Compositions Used In Study

1. Standard Asbestos Composition, nominally .6 C/S* ratio, 1:6 solids to water ratio.

   a. Theoretical composition on dry basis:

CaO	30%
Jasper X	10%
Dicalite 327-V	45%
Asbestos 4T28 Chrysotile	15%
	100%

   b. Batch composition:

Warner Calcium Hydrate	258 g.
Dicalite 327-V	387 g.
Jasper X	78 g.
Chrysotile 4 T 28 pulp, 80 freeness, 3.4% asbestos	4200 cc.

   Warner calcium hydrate is calculated as 72% CaO.
   Dicalite is calculated as containing 0% water.

2. Standard Kraft composition, nominally .6 C/S ratio, 1:6 solids to water ratio.

   a. Theoretical composition on dry basis:

CaO	30%
Jasper X	11%
Dicalite 327-V	44%
Kraft	15%
	100%

   b. Batch composition:

Warner Calcium Hydrate	295 g.
Dicalite 327-V	397 g.
Jasper X	78 g.
Kraft pulp, 80 freeness, 3.4% Kraft	2450 cc.
Water	1486 cc.

3. Clay compositions:

   a. .6 C/S, 8% clay composition

      (1) theoretical composition dry basis:

CaO	30%
Dicalite 327-V	42%
Dixie Clay	8%
Kraft	15%
	100%

Clay was calculated as 39.8% Al_2O_3, 44.8% SiO_2, 14% water

theoretical C/S ratio, S = Dicalite + SiO_2 of clay C/S = .62 or S = Dicalite + clay C/S = .57

      (2) batch composition:

Warner Calcium Hydrate	295 g.
Dicalite 327-V	339 g.
Dixie Clay	69 g.
Kraft pulp, 80 freeness, 3.4 Kraft	2450 cc.
Water	1500 cc.

   b. .6 C/S, 10% clay composition

      (1) theoretical composition, dry basis:

CaO	31%
Dicalite 327-V	44%
Dixie Clay	10%
Kraft	15%
	100%

theoretical C/S ratio, S = Dicalite + SiO_2 of clay, C/S = .63 or S = Dicalite + C/S = .58

*C/S ratio is the terminology used at Berlin indicating the weight ratio of CaO to silica raw materials, rather than to theoretical silica.

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TABLE VI (Continued)

(2) batch composition:

Warner Calcium Hydrate	275 g.
Dicalite 327-V	308 g.
Dixie Clay	72 g.
Kraft pulp, 80 freeness, 3.4% Kraft	2420 cc.
Water	1406 cc

e. .67 C/M, 10% clay composition

(1) theoretical composition, dry basis:

CaO	55%
Dicalite 327-V	45%
Dixie Clay	10%
Kraft	12%
	100%

theoretical C/M ratio, M = Dicalite + SiO_2 of clay or M = Dicalite + Clay C/M = .67 C/M = .73

(2) batch composition:

Warner Calcium Hydrate	283 g.
Dicalite 327-V	297 g.
Dixie Clay	70 g.
Kraft pulp, 80 freeness, 3.4% Kraft	2420 cc.
Water	1406 cc.

d. .8 C/M, 25% clay composition

(1) theoretical composition, dry basis:

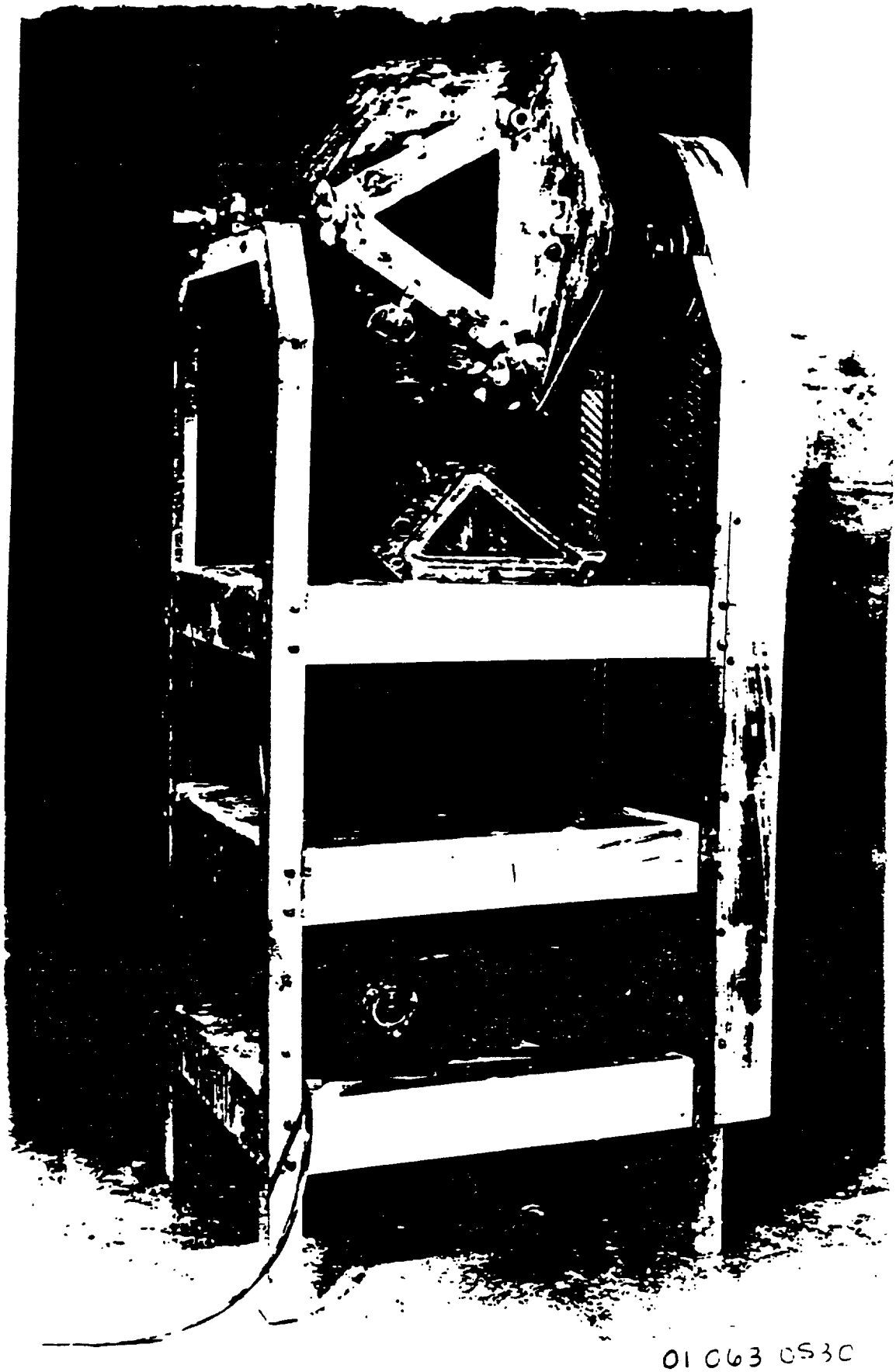
CaO	53%
Dicalite 327-V	30%
Dixie Clay	25%
Kraft	12%
	100%

theoretical C/M ratio, M = Dicalite + SiO_2 of clay: C/M = .8 or M = Dicalite + clay: C/M = .88

(2) batch composition:

Warner Calcium Hydrate	275 g.
Dicalite 327-V	200 g.
Dixie Clay	180 g.
Kraft pulp, 80 freeness, 3.4% Kraft	2420 cc.
Water	1406 cc.

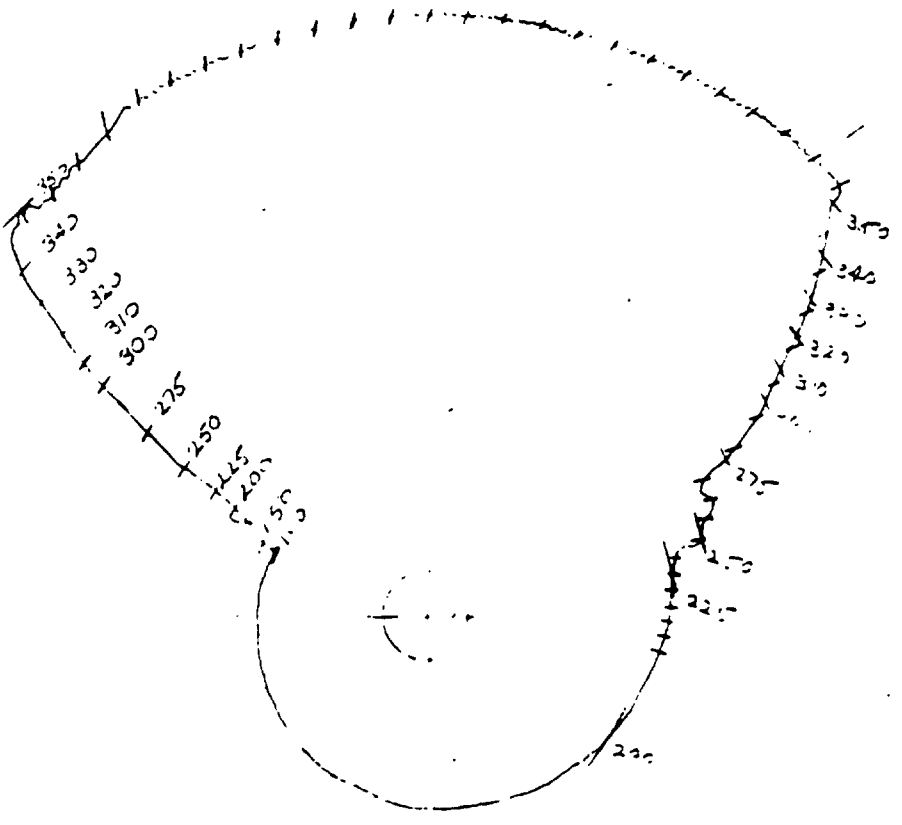
01 003 0529



01 063 0530

394 C

01 063 0531



TIME-TEMP. RECORDER CHART

EACH [illegible] = 15 MIN.

TEMPERATURE IN °F.

PLATE II

01 063 0532

01063053 3

PLATE III

01 063 0535

NINTH PROGRESS REPORT

ON

STUDIES OF KAYLO

TO

OWENS-ILLINOIS GLASS COMPANY

Arthur D. Little, Inc.
CHEMISTS-ENGINEERS
CAMBRIDGE 42, MASS.

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