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MEMORANDUM

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April 26, 1967

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KAYLO REINFORCEMENTS

Last week you asked me to prepare for you a brief status report covering the Kaylo Product Development program directed toward replacing asbestos in Kaylo.

Due to a combination of factors, this program is falling somewhat behind schedule. We have attempted to operate within the budget I and C allocated to us. A number of requests from I and C and major repairs to the SII cylinder not planned or budgeted for the first quarter consumed a substantial portion of the budget. We ran only \$710 in the red on Kaylo Product Development (P-84035) during the first quarter (\$9,395 in the black for the overall Kaylo program, including that sponsored by Manufacturing).

A substantial portion of our I and C sponsored budget, time and manpower was spent on (1) the purchase and testing of competitive insulations (requested by Del Ladd), (2) various activities related to the production and certification of the stress corrosion batch by duPont in February (timing and program set by Sedocky and Lovlin), (3) melting, drying and grinding of over two tons of 2379 glass at Granville for use in manufacturing of stress corrosion STS pipe and block for the test market program (Lovlin), (4) plant trials to produce approximately 20,000 pounds of stress corrosion product for test marketing (Lovlin) and (5) major expenditures for repairs to the SII cylinder (Swank and Schilling directed us to charge repairs against project).

In addition to the problems of time, manpower and unplanned program and requests from I and C Marketing, we have also been down four out of the last six weeks due to a series of mechanical breakdowns of the SII cylinder. For the 'replacement of asbestos' program, the key is survival of fibers through the SII cylinder. When the SII is down, so are we. At the moment we have a substantial backlog of fibers and fiber treatments to be evaluated as soon as the SII cylinder again becomes operational (estimated April 27 or 28 for completion of repairs).

All calcium silicate insulations on the market are reinforced with asbestos fibers. Asbestos fibers are low cost and resistant to alkali, they do not ball up or breakdown during mixing, they provide excellent reinforcing characteristics to the composite and have excellent adhesion to calcium silicate. Their only possible draw back involves a health hazard.

Even with all the above advantages of asbestos in Kaylo we must use a combination of grades and fiber lengths to achieve the overall strengths and handleability required. We use long fibered amosite asbestos to

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provide impact, flexural and tensile strength in the product. We use short fibered chrysotile asbestos to provide processing (reduce dusting and increase suspension of inserts in batch) and to eliminate cracking during drying. Over the years we have found that even a slight variation in fiber length or percentage of fiber used materially affects strengths and/or processing characteristics of Layla.

Since the first of the year we have surveyed just about every 'reasonably' priced fiber we could find, including organic, rockwool, ceramic and metal fibers. We have also screened many of our own textile glass roving products. The first step of our study has been to determine whether a fiber is resistant to alkali present in calcium silicate batch and especially when subjected to the pressures and temperatures of the Layla process.

All of our standard glass roving products, rockwool, as well as many organic and ceramic fibers failed to survive autoclaving. To date only metal fibers, alkali resistant glass (S) fibers, leached glass fibers (Refrasil type) and several organic fibers, including cotton, survive the autoclave.

Metal fibers were rejected because of their adverse effects on handleability and fabrication. All organic fibers, except cotton, were also rejected. Many organic fibers, including hemp and bagasse, survive the process, but shrink in size, thus providing no reinforcement to the composite.

This leaves just four 'classes' of fibers which have any probability of replacing asbestos in Layla. They include cotton, alkali resistant glasses, leached (Refrasil) S glass and, possibly, resin treated or inorganic sized glass.

The problem at the moment is all four of the above listed 'classes' of fibers seem to be suitable for replacing amosite asbestos only (those which provide the strength). We have not found to date any fiber to replace the short fibered chrysotile asbestos in Layla batch.

A number of attempts have been made to fabricate Layla pipe and block reinforced with all cotton, all alkali resistant (S) glass or all leached S (Refrasil) glass. In all cases the products produced developed hairline cracks during the drying. Strengths obtained were very low. It seems evident those fibers which showed good potential of replacing amosite asbestos with a small percentage of chrysotile asbestos. Initial results from such combinations show promise. A combination of 1% cotton, plus 7-1/2% chrysotile asbestos was used to replace the 15-20% asbestos normally in Layla. 2 1/2's comparable to standard Layla were obtained. At this point in our program we started to have JID cylinder problems. The program has been on hold since.

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To update the status of this program, we have not found to date a universal fiber which can be used to replace both amosite and chrysotile asbestos in layla. We have at least three and possibly four classes of fibers which show promise of replacing amosite asbestos. No substitutes for chrysotile asbestos have been found.

As soon as the SUD cylinder again becomes operational, samples containing cotton, alkali resistant glass and leached E (Refrasil) glass in combination with chrysotile asbestos, will be poured and submitted to Product Testing for evaluation. Major emphasis during the next several months will also be placed on finding a substitute for chrysotile short fibered asbestos.

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Following is a short outline and sketchy description of some of the more important batch changes that favorably and adversely affected the strength of the end product. Improvements were made to thermal values over the years. When any changes were made away from the basic Kaylo K10 light density formulation, an accompanying loss of impact and flexural strengths resulted. Naturally, a lower density gave lower strengths as well.

1. 1954

Asbestos changes were made, both in percentages of chrysotile and amosite as well as types of each.

2. 1955

No major batch changes.

3. 1956

Increased amounts of amosite asbestos, particularly AW grade.

4. 1957

Introduced various additives to K10 batch to improve thermal conductivity curve. Finally settled on limestone and chromite. Percentages were as high as 25 percent. Finally reduced to 12 percent, because of loss of strength. Removed clay from batch in a deliberate attempt to make a soft Kaylo similar to 85 percent magnesium. Due to low strength, increased breakage, replaced clay and improved end product quality. Asbestos raised to 20 percent and lowered back to 13.5 percent.

5. 1958

Began use of Kenite for Celetom and had to discontinue because of non-uniformity of product. Reduced additives in June to 9 percent to improve strength. Increased asbestos in October to improve K factor.

6. 1959

Tried Kenite again for Celetom and again had to remove it for analysis variations of too great a percentage. This was second trial of this material, for cost saving purposes. In August, cut Plant back to 5 days per week due to slack business and high inventories.

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7. 1960

Raised density to 12 pcf for an improvement in strength, handleability and offware. Introduced Kaylo dust to K10 batch.

8. 1961

Few batch changes, none major, keeping strength of end product fairly high due to customer's desire for a hard product in their manufacturing of fittings. Began full Plant operation on June 1.

9. 1962

Began introduction of coated glass fibers, both phenolic and vinyl base, for strength improvements and reduction of asbestos fibers. Began, also, the use of liquid sodium silicate and dry milled amosite asbestos. Removed coated glass fibers at year end.

10. 1963

Reduced density of K10 to 11 pcf. Not too many batch changes, all minor, except for removal of 4T chrysotile, substituting 6D1, also chrysotile.

11. 1964

Reduced density of K10 to 10-3/4 pcf. Experimented with powdered sodium silicate for prevention of stress corrosion, along with liquid sodium silicate. The latter made for an improvement in surface visual appearance of pipe insulation.

12. 1965

Substituted supersil for tripoli. Density remained at 10-3/4 to 11 pcf. Strengths declined.

13. 1966

Began use of 50 percent S33 short amosite for longer fiber W3 amosite. Stopped the use of powdered sodium silicate experiments. Substituted 7D3 chrysotile for 6D chrysotile asbestos. Strengths dropped. Introduced several bags of cement per batch and increased density to 11-1/2 to 11-3/4 pcf. These helped to increase the strength of end product some.

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