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GRAPHITE EXPANSION COMMITTEE MEETING OF

JUNE 6, 1947

By: W. E. Woods

Date: June 13, 1947

J A Christenson

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June 13, 1947

GRAPHITE EXPANSION COMMITTEE MEETING OF

JUNE 6, 1947

The seventeenth meeting of this committee was held on June 6, 1947. Present were Messrs. M. G. Barnard, J. T. Carleton, H. A. Fowler, P. F. Gast, C. W. Hay, E. Hilgeman, W. R. Lewis, J. H. Warren, V. W. Wood, and W. K. Woods.

Summary

The gas thermometer in the F Pile has been overhauled and re-calibrated. The readings are still in agreement with the readings from the graphite thermocouples. A similar overhaul of the gas thermometer in the D Pile will be made during June.

The progress of further outward bowing of Tube 2496-D can not be followed satisfactorily even though readings are obtained from both inlet and outlet ends of the tube. It is recommended that readings from the discharge end be discontinued, but that readings from the charge end should continue in order to follow the progress of any tube distortion at the inner end of the inlet gun barrel. It is also recommended that readings on Tube 2451-D should continue to be taken.

Preliminary results obtained from the one-tube mock-up suggest the possibility that the graphite adjacent to the gun barrels in the upper part of the D Pile may fracture after an additional expansion of about 50%, and that this fracturing may distort the tube locally so that 1.44-inch diameter pieces can not be passed through the tube. There is no sign that the tube would rupture and the phenomenon, if encountered, would not become apparent until after attempts had been made to discharge the tube.

There is definite indication that continued expansion of the graphite in the D Pile is causing an increase in both the frequency and severity of gun-barrel binding. This effect is not considered serious for new tubes at correct operating levels, but thermal expansion effects can rupture a tube with corroded Van Stone flanges if both gun barrels are immobilized.

The committee endorses the proposal that tubes in the top corners of the F Pile which have yet to be discharged for the first time should be left empty rather than re-loaded. This move would be in the direction of reducing the size of the pile in anticipation of the eventual abandonment of the pile.

Discussion

Laboratory Studies:

Experimental results have been obtained from graphite samples which were exposed in a dry process tube in an atmosphere of 90% helium and 10% CO₂. The

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samples accumulated an exposure of 175 MD/CT in slightly over two months. Previously unexposed graphite showed no dimensional change and a weight loss of 0.02%. Samples which had been previously exposed for 289 MD/CT showed a weight loss of 0.06% and a reduction in dimensional change from 0.21% before the test to 0.10% after the test. Interpretation of these results awaits experimental data from the control samples in pure helium.

New types of graphite have been received for exposure in the pile relative to their possible use in new piles. A large bar of graphite, 4" x 12" x 48", has been cut into samples for exposure as capsule samples, in receptacle slugs, and in the B Test Hole of the D Pile. This bar of coke-base graphite was prepared by methods similar to those used in fabrication of the pile graphite. The purpose of the study is to investigate the possibility that graphite bars of rectangular cross-section may expand preferentially in one direction. Some of these samples were started in the B Test Hole of the F Pile but had to be removed because of failure of this facility. The receptacle slugs referred to above are a new type of hollow uranium slug. X-ray studies and thermal-conductivity measurements on samples from this large bar both indicate a very random crystal orientation so it is not anticipated that marked differences in expansion in various directions will be encountered.

Three small samples, 0.426" diameter x 4" long, of graphitized lamp black have been received, in addition to three samples of gas-baked coke-base material which has not been graphitized. The former material has a thermal-conductivity which is only 1/9 that of KC green graphite and the thermal-conductivity of the coke-base material is only 2% that of the KC graphite. It is planned to expose two samples of each in receptacle slugs and one sample of each in the B Test Hole of the D Pile.

The helium thermometer in the F Pile has been overhauled and recalibrated. The results indicate that the gas thermometer readings are in good agreement with the thermocouple readings in the F Pile. It appears then that the gas thermometer in the D Pile may be reading abnormally high, possibly because of the presence of water in the thermometer. An overhaul of this thermometer is planned. The gas thermometer in the F Pile has a slight leak in consequence of its recent overhaul, but it is thought that this can be repaired.

In the event that it does appear desirable to use other gases than helium in new piles, discussion was held relative to changes in design which should be incorporated into the new gas purification building, Building 115. It was agreed that the only changes involved would be provision for additional gas storage and modification to the A make-up tank. These minor changes could be added after construction with but little extra expense compared to incorporating them in the present design.

Horizontal Bowing of Process Tubes:

Measurements of horizontal bowing of process tubes are made by sighting with a transit on a moving target drawn through the tube. The bowing of Tube 2496-D has now progressed so far that the target can be followed for only 16 feet in from either end of the tube, leaving a wide unexplored region in the center part of the tube. It was agreed that readings from the rear end of this tube

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need not be continued, but that periodic observations should be made from the front end in order to observe any bending of the tube at the inner end of the gun barrel. Such bending should be encountered at the inlet end before it is found at the outlet and because of the slight skew of the expansion toward the inlet end of the pile. Although a complete traverse is not being made on Tube 2496-D, continuation of traverse measurements on Tube 2451-D is desired because of the difference in behavior of this tube in the D and F Piles. Tube 2451-D has shown very minor increases in bowing; Tube 2451-F, which is already bowed more than the tube at D, is continuing to bow.

Work is being conducted on the design of new methods of measuring the horizontal bowing of tubes through which a line of sight cannot be established. The more promising apparatus consists of short lengths of flexible members coupled together by rigid soldered joints. After insertion in the tube the soldered joints would be melted, relieving the stress in the flexible members. The equipment would then be withdrawn from the tube and the shape of the "snake" could be studied outside the pile.

Vertical Bowing of Process Tubes:

Preliminary studies have been made in the one-tube mock-up on the effect of continued tilting of the graphite at the end of the gun barrels. Various results can be obtained depending upon the conditions of the test. The present slope of the graphite in the tube of the D Pile is about 0.35" per foot. It is shown in the mock-up that if the inner end of the gun barrel is prevented from rising as the graphite tilts and if the graphite is not tightly compressed the graphite block will rupture at a slope of about 0.5" per foot. The resulting distortion of the tube will prevent passage of normal process slugs or even 4" slugs past the end of the gun barrel. However, if the inner end of the gun barrel is free to rise as the graphite tilts or if the graphite surrounding the gun barrel is tightly compressed, tilting of the graphite causes bending of the gun barrel such that slopes of about 1" per foot can be encountered before process slugs fail to pass.

Present measurements of the elevation of various parts of the tube relative to a point outside of the tube are not sufficiently precise to give a good measure of the slope of the tube at any point. Equipment is planned which can be used for actual measurement of tube slopes for distances up to 10 feet in from the end of the tube. The slope gage would require about two man days of design time and two weeks in the shop. It is planned to go ahead with the development of this gage in order that conditions existing in the pile may be more accurately simulated in the one-tube mock-up.

Vertical Thimbles:

The realignment of vertical rod guides for rods which have caused trouble has been completed at the D Pile and is in progress in the F Pile. Development of the rod buffing machine has been completed and the machine is in use at the D Pile. Buffing has been confined to rods whose guides have been realigned. A film of oil is deposited upon the rod after buffing but there has been no opportunity for determining whether this lubrication has contributed to the improved functional performance of the rod.

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Horizontal rods:

The development of the new steel work construction in the inner rod room of the B Pile has been completed satisfactorily. As discussed in previous minutes, this construction involves the use of telescoping connections to take up motion of the rear side of the pile toward the rod rack. It is tentatively being planned to duplicate this installation at the D Pile during the summer and at the F Pile late in the summer. It was reported that installation in the inner rod room could be completed in two 8-hour shifts.

It was reported last month that longitudinal expansion of the graphite track had been investigated in Thimbles A, 2 and B in all piles. W. P. McCue has noted that no expansion had been encountered in the number 2 Thimble and has proposed that endwise expansion of the graphite around the center of the Pile may cause a bowing in the A and B thimbles which could account for the apparent graphite expansion. Further study, however, shows that no more than 3/16-inch of graphite displacement would be expected if the expansion were symmetrical about the center and that, since the clearance between the thimble and the graphite is 3/8 of an inch, bowing of the thimble is an unlikely explanation for the apparent expansion of the graphite track.

Slight trouble is still being encountered on rare occasions with the Number 6 Horizontal Rod in the F Pile. The general behavior of the Number 6 Rod, however, is so satisfactory that no further investigation is planned at this time. If the condition should become worse it is planned to study the horizontal bowing of this thimble.

Tube Replacement:

The innermost foot of the bore of a gun barrel is being enlarged in the shops. It is proposed to use this gun barrel in the one-tube mock-up in an effort to demonstrate that enlarging the bore will be beneficial in replacement of badly bowed tubes. Preliminary design has been made for a grinder to use in enlarging the bore of gun barrels, but further work on the grinder will await the development of information relative to the amount and location of the grinding which will be required.

Gun Barrel Binding:

There is definite indication of increased gun barrel binding for tubes in the top part of the D Pile. Full and reproducible movement of Tube 3959-D was encountered in January, but jacking tests on this tube in May produced no movement of the rear gun barrel at a load of 1000 pounds. Comparable results were obtained for Tube 3474-D. Tube 4088-D was jacked in August of 1946; movement was obtained but the movement decreased with repeated jacking, indicating the presence of binding. Recent measurements on Tube 4088-D show that the gun barrels are now tight and cannot be moved at 1000 pounds. Tube 4168-D which previously showed full and reproducible movement now shows binding as evidenced by decreased movement with repeated jacking.

This pronounced increase in amount of binding suggests that both front and rear gun barrels of tubes in the top part of the pile may be some severely

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bound as time goes on. Recent work in the B Pile has indicated that the thermal expansion and contraction of process tubes will not cause rupture of the Van Stone flanges at the present time. With continued corrosion of the Van Stone flanges, however, the effects of gun barrel binding become more serious. Extensive binding of gun-barrels will of course impede efforts to monitor endwise expansion of the graphite.

Empty Tubes:

In each corner of the F Pile there remain some twenty-five tubes which have not been discharged since the pile started up. If these tubes are reloaded during the summer it will be a matter of several years before they would attain normal product concentration. The likelihood that these tubes may have to be discharged prematurely with the consequent loss of metal suggests the advisability of leaving these tubes empty at such time as the initial charge is finally discharged. This procedure would cost 15 to 25 inhours of reactivity and would have a very minor effect upon the sensitivity of the A-rod. This course of action is further suggested by the possibility that some tubes may have their charge trapped as the result of graphite fracture at both front and rear gun barrel. The expectation that the piles may become inoperable in a few more years makes it logical to start reducing the size of the piles.

General

The next meeting of the committee is scheduled for July 11, 1947.

W. K. Woods
W. K. Woods
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