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January 23, 1948
1947

GRAPHITE EXPANSION COMMITTEE
MEETING OF JANUARY 10, 1947

The thirteenth meeting of this committee was held on January 10, 1947. Present were Messrs. M. G. Barnard, H. A. Fowler, P. F. Gast, C. W. Hay, E. Hilgeman, W. R. Lewis, R. A. Rohrbacher, J. H. Warren, V. W. Wood, and W. K. Woods.

Summary

The horizontal bowing of Tube 4494-D in the top corner of the pile is considerably greater than the bowing which can be attributed to graphite expansion at this elevation in the pile, indicating that the top layers of graphite are being dragged outward by expansion of the underlying layers. Such a phenomenon could shear the vertical thin plates.

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at a point just below the thermal blocks. Equipment is to be developed for measuring any eccentricity between the rod guide and a section of the thimble located just below the end of the guide.

Jacking tests using forces up to 4000 lbs. on gun-barrels which show binding have demonstrated that binding is still present at these high forces. It is recommended that no further jacking tests be performed on gun-barrels which are known to exhibit binding.

Rupture tests on Tube 4082-B caused failure of the rear Van Stone joint after the tube had been stretched 1/2 inch. The amount of tube stretch before failure of the flange will probably be affected primarily by corrosion of the flange and, for the same reason, failure of the rear flange is expected in preference to the front flange.

Discussion

Laboratory Studies

A sample of graphite which had been exposed for 1182 MD/CT showed a shrinkage of 0.07% in the direction of extrusion. This result is in agreement with the reported shrinkage in the a_1 lattice spacing as obtained from X-ray studies. The a_1 spacing is a measure of the distance between atoms in a given crystal plane, in contrast to the a_3 spacing which is a measure of the distance between planes.

Annealing studies reported last month for 650° C. were extended at a temperature of 600° C. using graphite samples from the track of the No. 9 Thimble of the D Pile. After annealing for 5.5 hours the samples were cooled, measured, and re-heated for an additional 45 hours. In the following table, C/Co is the ratio of the crushing strength after annealing to the crushing strength of unexposed graphite; the value of C/Co before annealing was 2.24.

	<u>Helium</u>		<u>Helium +1.8% Oxygen</u>	
Annealing time (hrs.)	5.5	10	5.5	10
Expansion recovery (%)	55	55	68	68
Weight loss (%)	0	0	0.8	1.3
C/Co	1.48	1.40	1.41	1.2

The samples used in the above test were 1/4-inch diameter. The committee is interested in obtaining crushing strengths from large samples and the use of 3.5-inch diameter graphite rods from the D Holes was proposed. There is a 75-ton hydraulic press in the 100-F Maintenance Shop which would presumably be available for this purpose. Consideration is to be given during the coming month to a program of study using large graphite samples.

Bowing of Process Tubes

Probe tests are being made on each of 240 process tubes in the top

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central region of both the D and F Piles as they come up for normal discharge. This work is being carried out under Production Test No. 105-81-P. The purpose of the test is to determine the progress of tube distortion at the end of the gun barrels as caused by vertical expansion of the graphite. The operation consists of inserting over-size steel dummy slugs, 8.7 inches long and of various diameters, a distance up to 10 feet in from the Van Stone joint. As a general rule only the front end of a tube is probed.

Tube 4494-D was traversed for both horizontal and vertical bowing on January 7, using a moving target and a transit or Wye-level. Both horizontal and vertical bowing exceeded 1-1/4 inches at the maximum. This amount of vertical bowing is larger than had been expected, amounting to more than 50% of the vertical bowing of Tube 4674-D, although the exposure of tubes in the 84 column is less than 40% of the exposure of tubes in the 74 column. This effect may indicate either or both of two possibilities: (a) the expansion of graphite may be affected by the operating graphite temperature; so that graphite near the fringe of the pile expands at a faster rate per unit of exposure than does the central graphite because of the difference in temperature, or (b) the rate of expansion of graphite per unit of exposure may decrease after prolonged exposure such as the central graphite in the pile has experienced. The preceding remarks are applicable to horizontal bowing, but in addition graphite near the top of the pile could conceivably be dragged outward by expansion of the underlying graphite.

Bowing of Vertical Thimbles

As mentioned above, Tube 4494-D was found to be bowed outward about 1.5-inch, although Tube 2496-D is bowed outward only 1.6-inch. Since the exposure of graphite associated with the 44 row is less than 40% of that in the 24 row, there is definite indication that the overlying graphite is being dragged outward by the expansion of the central graphite. The possibility therefore exists that the vertical thimbles near the sides of the pile may be bent sharply at a point just below the cast iron blocks. Barnard was asked to develop equipment which could be passed through the rod guide and used to determine any eccentricity between the rod guide and a section of the thimble located from 1 to 18 inches below the end of the guide.

It was reported that the rod guide for Vertical Thimble No. 37 at the D Pile was no longer truly vertical but that the upper end sloped outward away from the rest of the rods toward the discharge face. This phenomenon would be expected for all rods in that row, for the roof is substantially level from side to side but follows the contour of the top of the graphite from front to rear.

Gun-Barrel Binding

The tests on Tube 4082-B were described in detail. These tests will be reported in full in Interim Report No. 8 of Production Test No. 105-52-P, which is now being prepared. In brief, it was found that when the rear

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gun-barrel was jacked with 4000 lbs. of force evidence of binding (decreased clearance after repeated jacking) was still being encountered, and that when a jacking force of only 1750 lbs. was subsequently used the motion of the rear gun-barrel was only $5/32$ inches. Having determined that binding still prevails at forces comparable to those required to rupture Van Stone joints, it is the opinion of the committee that no more jacking tests should be done on gun-barrels which are known to exhibit binding.

As an additional part of the tests on Tube 4082-B the gun barrels were locked in place and the tube was jacked back and forth fifty times inside the gun barrels in order to simulate the conditions which could arise from use of a split gun barrel with an operating tube. The tube was examined after it was removed from the pile, and a fair amount of galling of the upper part of the outside surface of the tube was noticed at a position corresponding to a point inside both gun barrels and located about three inches from the inner end of the gun barrel. However, the condition was not considered serious.

Endwise Expansion of Pile Graphite

Before removing Tube 4082-B from the pile the tube was ruptured by pulling on the front gun barrel when the rear gun barrel was locked in position. Rupture occurred at the rear Van Stone flange when a tensile force was applied to the front gun barrel, but the tensile force on the rear Van Stone flange was probably only some 3200 lbs. because of binding in the front gun barrel. The associated tube stretch was only $1/2$ inch just before rupture; $3/32$ of this stretch was permanent strain.

The above data demonstrate that the aluminum has not been annealed under process conditions, and hence that the aluminum tube can not be stretched as much as had previously been considered conceivable. The rear Van Stone flange was moderately corroded; flanges with more severe corrosion would fail at stresses corresponding to considerably smaller amounts of tube stretch.

Tube 4082-B was found to have fairly deep scratches on the outside surface. V. W. Wood agreed to start development of equipment for honing the inside surface of the gun barrels before replacing the tube. After Tube 4082-B has been replaced it is intended to investigate the cause of tube binding in Tube 4385-B. This tube assembly is unique in that the tube could not be moved with a force of 1000 lbs. at a time when the gun barrels were locked in position. Test work is to consist of repeated jacking of the tube alone at higher forces, followed by rupture tests, tube removal, and inspection of the outside of the tube to determine the location of the binding. Completion of work on Tube 4385-B will complete the program of work currently contemplated on tubes in the B Pile.

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