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GAS-COOLED GRAPHITE STUDIES- MONTHLY REPORT - SEPTEMBER, 1960

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RF:HAH

The FY-1961 cost in dollars through September 30, 1960, are as follows:

	Actual FY-1961 Costs	Current FY-1961 Estimates
Physics	$ 6,000*	$ 5,000
Graphite	116,171	652,000
Gas-Cooled Loop	17,374	349,000
	$ 139,545	$1,006,000

(*Completed)

4000 PROGRAM- REACTOR DEVELOPMENT (GAS-COOLED REACTOR POWER PROGRAM)

GRAPHITE STUDIES

EGCR Burning Hazard Evaluation

Data from initial experiments on the EGCR graphite oxidation prototype demonstrated several combustion characteristics of the reactor. The data must be normalized to actual reactor conditions to be applied; however, the following trends should still be valid:

1. Runaway (or uncontrolled temperature rises) can occur with graphite temperatures as low as 400°C and inlet air at room temperature. However, the temperature rise rate is slow, up to about 650° C ($\leq 1^\circ$ C/min). Thus, a considerable safety factor is provided.

2. When a severe runaway has been established ($T_G \geq 740^\circ$ C) the graphite temperature rises exponentially. Increased air flow, up to eleven-fold, served only to make the runaway more severe, rather than arrest its course.

AIRMAIL

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Graphite Air Oxidation

Experiments to date indicate gamma irradiation significantly increases graphite oxidation by oxygen at temperatures up to 650° C. An increase of oxidation rate by a factor of 16 is noted at 650° , however, the activation energy of the gamma enhanced reaction appears to be 10 to 15 kcal/mole lower than the thermal rate. Therefore, the effect becomes greater as temperature decreases.

Oxidation of SiC-Coated Graphite

The first group of SiC-coated graphite rods from the Carborundum Company that had been in reactor and received approximately 3000 MWD/AT exposure were tested for oxidation resistance. The samples were run at 1000° C with an air flow of 1 cfh. Five samples were tested -- one failed after less than 75 hours and the other four ran 244 hours with no signs of failure. Failure was indicated by excessive weight loss of the graphite.

Thermal Cycling of SiC-Coated Graphites

As part of the coatings evaluation program, five graphite spheres coated with siliconized SiC by the Minnesota Mining and Manufacturing Company were thermal cycled in air from 200° C to 1200°C at 6 cycles/hr. After 58 hours one sphere had developed circular cracks and showed a weight loss. All others showed no cracks and a slight weight gain of 2-3 milligrams.

Microwave Activation of Nitrogen Gas

Studies of the weight loss rate of graphite in flowing nitrogen (700 μ pressure) activated by a microwave discharge are continuing. The specific weight loss rate appears to decrease with an increasing number of hours in the glow. Total times in glow from $\sim$1.5 to $\sim$24 hours have been used giving weight loss rates in the range of 2×10^{-4} to 8×10^{-5} gm/gm-hr.

Surface Oxide Formation

Studies are continuing on graphite surface oxide formation in flowing CO_2 and CO systems. Preliminary results using CO as the gas show a weight gain of 4.15 mg in 87.5 minutes at 800° C. The rate of approach to equilibrium is of the same order of magnitude as in the CO_2 system.

GETR Irradiation of EGCR Graphite

The H-3 capsule in the GETR is scheduled for removal after 4 cycles of irradiation on October 3. Samples in the capsule will be measured and then prepared for reinsertion into the GETR. Part of the samples will be replaced with actual EGCR graphite now on hand and being machined into samples.

4000 PROGRAM - GRAPHITE IRRADIATION DAMAGE STUDIES

Microscopy

A workable method for studying selected areas on graphite specimens before and after irradiation with the electron microscope has been developed. The specimens are prepared by hand or Syntron lapping techniques followed by a cathodic etch. Areas of interest are then referenced with a marking pin mounted on an optical microscope. Graphite fragments produced during scribing are removed with repeated application and stripping by Formvar replicating films. A series of light micrographs are then taken of both the graphite and negative carbon replica at magnifications of 50 to 750 X. These serve as guides in locating and mounting carbon replicas of the selected areas on grids for electron microscopy. A two-stage petrographic microscope is used for aligning the replica with a grid opening. The high resolution of the electron microscope results in a considerably different impression of the structural details of graphite than given by light microscopy; however, an area of interest referenced by light micrographs has been identified with the electron microscope and photographed at magnifications up to 40,000 X. The sample will be replicated with several different methods for comparison and then irradiated to an exposure of 500 to 1000 MWD/AT at 30° C for the initial post-irradiation studies.

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