

Measurements of Kinetic Parameters of Nuclear Graphite IG-110 for HTGR Air-ingress

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Abstract

In order to investigate the chemical behavior of the graphite during an air-ingress accident in high temperature gas-cooled reactors, kinetic tests on nuclear graphite IG-110 were performed in chemical reaction dominant regime. In the experiment, inlet gas flow rate ranged from 8 to 18 SLPM, graphite temperatures from 540 to 630°C and inlet oxygen mole fractions from 3 to 30 %. He/O₂ mixture was used as a reacting gas.

The test section was made of a quartz tube, which has 75 mm diameter and 750 mm length. The specimens with 21 mm diameter and 30 mm length were supported in the center of quartz tube by the ceramic rod. The 15 kW induction heater was used to heat the specimen. The graphite temperature was measured by 2 infrared temperature sensors. The concentration of each component of gas mixture introduced to the gas sampler was analyzed by NDIR (non-dispersive infrared) gas analyzer.

The oxidation rate was calculated from the inlet and outlet concentration of O₂, CO, CO₂. The order of reaction (n) was estimated as 0.75 ± 0.146 with 95 % confidence level. It was not affected by the burn off ratio and oxidation temperature. With activation energy (E_a) data obtained for different oxygen concentration and flow rate conditions, 218 ± 3.76 of E_a was obtained within 95% level of confidence. It was found that the activation energy was not affected by oxygen concentration.