The Dilation of Neutron Irradiated Graphite Exposed to Liquid Sodium

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Abstract

The increase in dimensions of graphite exposed to liquid sodium is examined, for both unirradiated and fast neutron irradiated specimens of Pile Grade 'A' and near isotropic graphites.

Unirradiated specimens show a dilation which correlates reasonably well with the thermal expansion coefficient, and supports previous work* in which it was observed that intercalation of sodium into the graphite lattice caused 'c'-spacing changes of about 5%.

Specimens irradiated to fast neutron doses in the range 10^{20}–10^{22} n.cm^{-2} and then exposed to liquid sodium, show dilations which are dependent on the irradiation history of the specimen and are much greater than those for unirradiated graphite. The dilation increases with the fast neutron dose the specimen has received, and at high doses complete disintegration occurs. Specimens irradiated at temperatures of about 300°C show much greater sodium dilations than those irradiated to the same dose at temperatures > 350°C.

Restraint tests were also carried out by fitting specimens into steel cans of different wall thickness before exposing to liquid sodium. The specimen dilation is thus restrained, and stresses are set up which cause measurable plastic strains in the can and which, under extreme conditions, lead to complete failure of the can. It is inferred from these tests that compressive stresses partially inhibit sodium take up by the graphite.

*ASHER, R.C. J. Inorg. Nucl. Chem. (1959) 10 238.