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Evaluation of various carbon blacks and dispersing agents for use in the preparation of uranium microspheres with carbon[1]

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Abstract

A comparison study on carbon blacks and dispersing agents was performed to determine their impacts on the final properties of uranium fuel kernels with carbon. The main target compositions in this internal gelation study were 10 and 20 mole % uranium dicarbide (UC_2), which is $UC_{1.86}$, with the balance uranium dioxide. After heat treatment at 1900 K in flowing carbon monoxide in argon for 12 h, the density of the kernels produced using a X-energy proprietary carbon suspension, which is commercially available, ranged from 96% to 100% of theoretical density (TD), with full conversion of UC to UC_2 at both carbon concentrations. However, higher carbon concentrations such as a 2.5 mole ratio of carbon to uranium in the feed solutions failed to produce gel spheres with the proprietary carbon suspension. The kernels using our former baseline of Mogul L carbon black and Tamol SN were 90−92% of TD with full conversion of UC to UC_2 at a variety of carbon levels. Raven 5000 carbon black and Tamol SN were used to produce 10 mole % UC_2 kernels with 95% of TD. However, an increase in the Raven 5000 concentration led to a kernel density below 90% of TD. Raven 3500 carbon black and Tamol SN were used to make very dense kernels without complete conversion to UC_2. The selection of the carbon black and dispersing agent is highly dependent on the desired final properties of the target kernels.