Processing of Spent TRISO-Coated GEN IV Reactor Fuels

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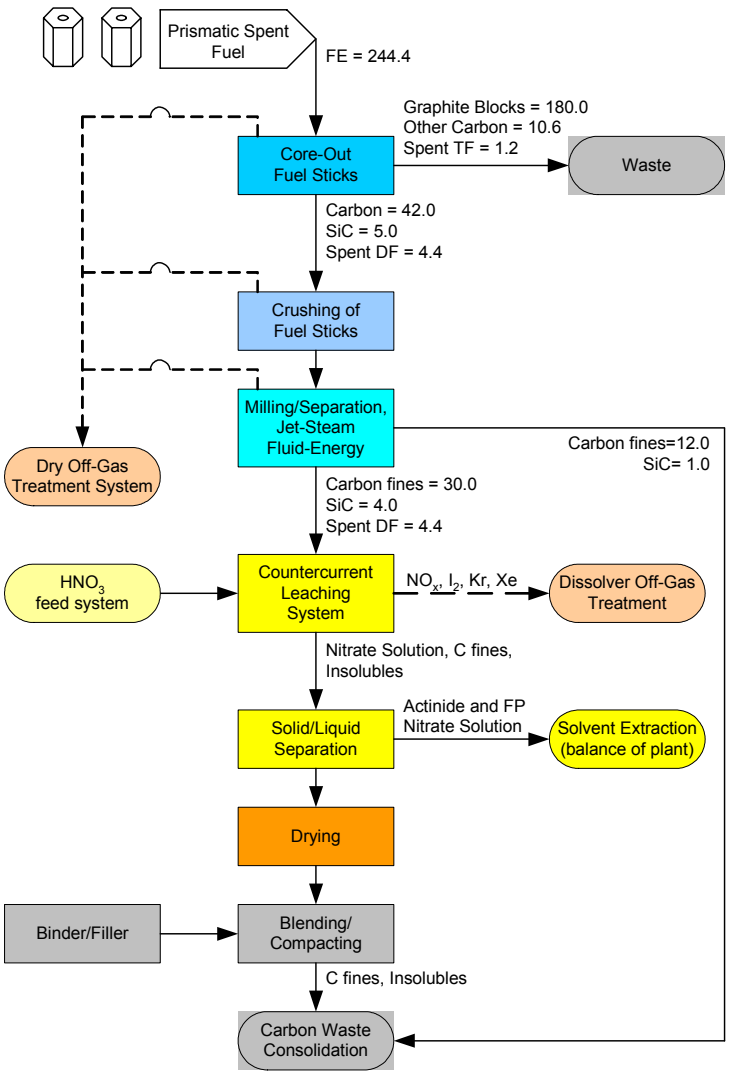
There has been renewed interest in coated-particle nuclear fuels for high burn-up and high temperature applications. Tri-isotropic (TRISO) coated fuels are comprised of an oxide fuel kernel coated with a porous carbon layer, a strong pyrolytic carbon layer, and a very tough silicon carbon layer. The SiC layer is usually coated with another pyrolytic carbon layer to provide a bonding surface with the carbon matrix used to fabricate fuel compacts. These fuel compacts are loaded into a machined graphite fuel element. Because there is only a relatively small amount of fuel in a sea of carbon that contains ^{14}C, processing these fuels to recover the fissile materials presents special problems.

Historical approaches to processing TRISO-coated fuel involved crushing and burning operations to reduce the fuel elements (thereby increasing the surface area), breaching the SiC layer, and removing the carbon components from the fuel as gaseous carbon dioxide. The oxide fuel was then easily separated from the remaining SiC fragments by dissolution in nitric acid. The primary disadvantage to this method is the need to capture and sequester the ^{14}C-containing CO_2. Sequestration using calcium hydroxide results in a large increase in the mass and volume of waste compared with that of the original carbon.

A process has been proposed to separate the carbon from the fuel without oxidation of the carbon component, (see accompanying figure). It relies on removing the fuel compacts from the graphite-block fuel element, grinding the fuel compacts to a very small particle size, and leaching the fuel components from the finely divided carbon using methods similar to those industrialized for graphite purification. The residual carbon waste and any undissolved residues can be consolidated into a compact waste form that has excellent characteristics. This paper will present the proof-of-principle experiments for the leaching step.



I propose this communication to be presented as: An oral presentation.

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