Recycle and reuse of HTGR graphite*

Tim Burchell, Pete Pappano
Materials Science and Technology Division
Oak Ridge National Laboratory
Oak Ridge, TN, United States

Abstract

Over the life of a high-temperature gas-cooled reactor a significant number of nuclear graphite components will be replaced, creating a radioactive materials management issues, including storage, transportation and burial, all with associated costs and environmental implications. One potential solution to the irradiated graphite management issue is to reuse/recycle the graphite. Reuse of irradiated graphite could be as straightforward as shuffling the graphite components within the reactor to maximise the useful life of that material. The recycle option would use expended graphite blocks as the raw material for making fresh components. This latter option is essentially the production of new graphite components through a true recycle process. Here we report the first experimental study into the viability of recycling nuclear graphite.

Preliminary investigations into the viability of recycling irradiated nuclear graphite were separated into three areas: i) A study of the viability of recycling non-irradiated graphite was carried out by GrafTech International (GTI), under contract to Oak Ridge National Laboratory (ORNL), who carried out a parametric study, with parameters of grinding, mixing, forming and heat treatment. The product and properties were then evaluated by ORNL. ii) A series of experiments was carried out to determine the annealing kinetics of irradiated graphite for an annealing range appropriate to the recycle process. The crystal annealing kinetics was elucidated by measurement of electrical resistivity and specimen dimensions. iii) A series of nuclear graphite specimens, similar to that studied by GrafTech International, but that had been irradiated in the High Flux Isotope Reactor, were recycled.

In the preliminary work reported here the goal was to determine if nuclear graphite, produced through the normal graphite forming process, but using crushed, previously irradiated nuclear graphite, can be manufactured with sufficient mechanical integrity to warrant further investigation. Results suggest that, within the narrow parameter range studied, the materials could be formed with a level of density, strength and thermal conductivity to suggest that the recycling process is viable. It is noted that the irradiated materials used in this study were in a moderate range of irradiation associated with graphite densification, and that recycling would likely include graphite irradiated to a higher irradiation dose.

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* The full paper being unavailable at the time of publication, only the abstract is included.