A REASSESSMENT OF THE EFFECTS OF HELIUM ON CHARPY IMPACT PROPERTIES OF FERRITIC/MARTENSITIC STEELS - D. S. Gelles and M. L. Hamilton (Pacific Northwest National Laboratory)* and G. L. Hankin (Loughborough University, England)

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EXTENDED ABSTRACT

To test the effect of helium on Charpy impact properties of ferritic/martensitic steels, two approaches are reviewed: quantification of results of tests performed on specimens irradiated in reactors with very different neutron spectra, and isotopic tailoring experiments. Data analysis can show that if the differences in reactor response are indeed due to helium effects, then irradiation in a fusion machine at 400°C to 100 dpa and 1000 appm He will result in a ductile to brittle transition temperature shift of over 500°C. However, the response as a function of dose and helium level is unlikely to be simply due to helium based on physical reasoning. Shear punch tests and microstructural examinations also support this conclusion based on irradiated samples of a series of alloys made by adding various isotopes of nickel in order to vary the production of helium during irradiation in HFIR. The addition of nickel at any isotopic balance to the Fe-12Cr base alloy significantly increased the shear yield and maximum strengths of the alloys. However, helium itself, up to 75 appm at over 7 dpa appears to have little effect on the mechanical properties of the alloys. This behavior is instead understood to result from complex precipitation response. The database for effects of helium on embrittlement based on nickel additions is therefore probably misleading and experiments should be redesigned to avoid nickel precipitation.

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