



Remark About “Finely Divided Metal as Nuclear Reactor Fuel”

W. Van Snyder *

La Crescenta, California

In Ref. 1, Till and Chang remark on the importance of the relationship of the thermal conductivity of fuel to the inherent safety of a reactor.

“Finely Divided Metal as Nuclear Reactor Fuel”² recommended that experiments ought to be conducted to determine the relationship between the volumetric density of fuel particles in sodium, and thermal conductivity. That work had already been done in the more general context of two-phase liquid-solid systems and should have been used and cited. Equation (6.4) from Ref. 3 provides an estimate:

$$\frac{\kappa_p}{\kappa_{\text{Na}}} = 1 + 3\beta\phi + 3\beta^2\phi^2 \left(1 + \frac{9\beta}{16(\beta+5)} + \frac{\beta}{4} + \frac{\beta^2}{2^6} + \dots \right) + O(\phi^3), \quad (1)$$

where $\alpha = \kappa_f/\kappa_{\text{Na}} \simeq 0.556$, κ_{Na} = the thermal conductivity of liquid sodium $\simeq 62.9$ W/m/K (Ref. 4, p. 101), κ_f = the thermal conductivity of uranium $\simeq 35$ W/m/K, and $\beta = (\alpha - 1)/(\alpha + 2) \simeq -0.314$. With ϕ , the volume fraction occupied by metallic fuel, ranging from 0.6 to 0.95, κ_p declines nearly linearly from about 40 to about 36 W/m/K.

At all volumetric densities of fuel particles in sodium, the thermal conductivity of the mixture is greater than the thermal conductivity of solid metal.

Disclosure Statement

No potential conflict of interest was reported by the author.

ORCID

W. Van Snyder  <http://orcid.org/0000-0002-8293-4741>

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*E-mail: van.snyder@sbcglobal.net