Baumann has used the formula

$$\frac{1}{D} = \frac{1-f}{D(D_2O)} + \frac{f}{D(H_2O)} \tag{5}$$

to correct for light water contamination. Here, f is the mole fraction of light water. A more accurate expression for small values of f can be written

$$\frac{1}{D} = \frac{1-f}{D'(D_2O)} + \frac{f}{D(H_2O)}$$

$$\cdot \int_0^\infty dE\, M(E) \left[\frac{\lambda(E)}{\langle\lambda\rangle}\right]^2_{D_2O} \left[\frac{\langle\lambda\rangle}{\lambda(E)}\right]_{H_2O} \tag{6}$$

where

$$\lambda(E) = 1/\Sigma_{tr}(E)$$

$$\langle\lambda\rangle = \int dE\, M(E)\lambda(E).$$

The integral in (6) was evaluated and found to be 1.027 and independent of temperature. Since the second term in (5) is only 3% of the first term for this experiment, the use of Eq. (5) to correct for light water will be accurate to better than 0.1%.

A final question arises as to whether a spectrum correction for an infinite homogeneous medium can be applied to a heterogeneous lattice measurement. We have attempted to answer this question by calculating the actual spatial and energy distribution of the flux in Baumann's 11.56 cm pitch lattice at room temperature (the most highly absorbing case). For this case we find that the non-Maxwellian correction reduces $1/L^2$ by 0.650% for a homogeneous medium and by 0.621% for the heterogeneous lattice. Thus the usual diffusion cooling (heating in this case) correction can be applied in this case. It should be noted, however, that the lattices considered here are very dilute and the copper tube is quite thin. The variation of the average velocity is only 3% across the cell.

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Re: A Remark on the Measurement of the Diffusion Coefficient for Thermal Neutrons*

Dr. Honeck's new calculations of the spectral hardening correction for my measurements of the thermal diffusion coefficient for D_2O make an interesting and valuable addition to the study. Since my original paper was primarily experimental, the analysis was deliberately kept at the simplest level consistent with the precision of the data, but the corrections were given separately to make possible later improvements such as those suggested. Like Dr. Honeck, I had found that use of more precise terms for the H_2O and heterogeneity corrections made essentially no difference in the numerical results. Likewise a test of the spectral hardening term against H_2O data had given excellent results as had the test against Dexter's D_2O data.

The rather large discrepancy between the term used and Dr. Honeck's calculations for D_2O is, in fact, rather surprising. Diffusion cooling terms calculated by my method and by Honeck for H_2O and graphite are in good agreement both with each other and with experiments. Calculations by my method also agree well with the average of the diffusion cooling measurements for beryllium. Further, in the case of D_2O my correction reconciles Dexter's data somewhat better than does Honeck's. On the other hand Honeck's corrections appear to rest on much more secure theoretical grounds and also give better agreement with the measured diffusion cooling term for D_2O in pulsed neutron experiments.

To help resolve the discrepancy we are planning experiments with deep poisoning cases. Monte Carlo calculations are also underway to determine the effect of epithermal neutron feed on the equilibrium thermal energy distribution in poisoned D_2O.

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