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LETTER TO THE EDITORS

Temperature Dependence of the Thermal Diffusion Length in Water

The temperature dependence of the thermal diffusion length in water has been given by Fermi (*1*) to be, $L = 2.64 + 0.0061T$ (L in cm and T in °C). This expression is based on the unpublished work of Wilson, Bragdon, and Kanner, who made several measurements in the temperature range 27.2–93°C. For a Maxwellian neutron spectrum, the analysis of these results reveals that the assumption of a $1/v$ energy dependence of the hydrogen transport cross section gives an excellent fit to the data.

The recent measurements of Von Dardel and Sjöstrand (*2*) yield a thermal diffusion length of 2.725 ± 0.03 cm at 22°C. This result is in very good agreement with the measurement of De Juren and Rosenwasser (*3*) corrected for the effect of the buckling on the neutron temperature (*2*). Using this value of the thermal diffusion length and assuming the $1/v$ dependence, the transport cross section of hydrogen in water at a velocity of 2200 meters/sec is 37.14 barns.

The diffusion length at any other temperature can be found from the value at 22°C using the following expression:

$$L = \frac{2.719}{\rho}\left[\frac{T + 273.1}{295.1}\right]^{\frac{1}{2}}\left[\frac{1.0614}{1 + 0.0614\left[\frac{T + 273.1}{295.1}\right]^{\frac{1}{2}}}\right]^{\frac{1}{2}}$$

where ρ is the water density and T the temperature in °C. This expression agrees very well with the results of Wilson, Bragdon, and Kanner, as well as with the results of Antonov *et al.* (*4*) who made measurements at 23°C and 80°C. Using the above expression for the diffusion length and approximating it by a linear temperature dependence in the 10–30°C and 30–90°C temperature intervals, the temperature coefficient in the range 30–90°C is 0.0059 cm/°C, while in the range 10–30°C the value is 0.0049 cm/°C. This latter value is in somewhat better agreement than the Fermi prescription with the value of 0.003 cm/°C reported by Von Dardel and Sjöstrand over a similar temperature range.

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