7.3 THE DIFFUSION LENGTH IN WATER AND GRAPHITE

To be able to use the slow neutron diffusion equation (7-3), it is necessary to know the value of L, the diffusion length. Measurement of L for water can be accomplished by placing a water tank on a pile (or on the thermal column of a pile), as in Figure 43. Provided diameter and height of water are very much greater than the diffusion length itself, the problem may be considered to be one dimensional. The bottom surface is a plane source of thermal neutrons. Equation (7-3) becomes:

$$d^2n/dx^2 - (n/L^2) = 0$$
$$n = n_0 e^{-x/L} \qquad (7\text{-}8)$$

where x is the distance from the bottom of the water tank. Measurements are made with and without cadmium separating the pile and water tank to determine (by subtraction) n for thermal neutrons as a function of x. The exponential decrease of n with x as predicted in equation (7-8) is measured and L determined for water. The value is $L_{water} = 2.8$ cm. If a block of paraffin is used, the result is the same, showing that the absorbing mechanism in the case of water and paraffin is the same; namely, hydrogen capture. The effect of carbon or oxygen absorption is negligible compared to hydrogen.

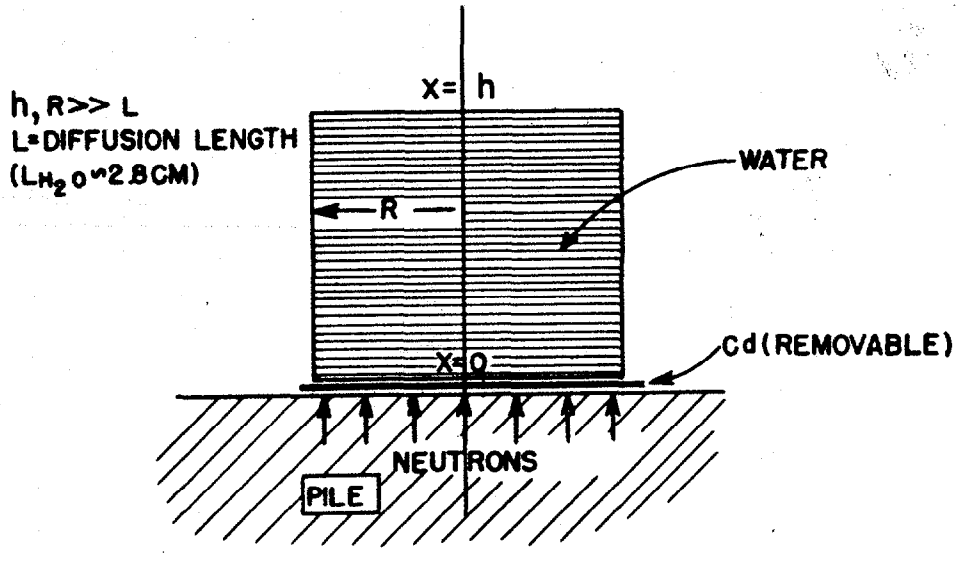

Figure 43. Measurement of diffusion length in water.