Physics Group IV

H. L. Anderson

Capture of Heavy Water: (Anderson, Molloy, Nagle)

A determination of the capture of heavy water was made by observing the change in the critical position of the control rod of the Argonne pile when heavy water was substituted for graphite in 80 cells of the pile. The amount of graphite which was removed was chosen to have the same slowing-down power as heavy water. The results are given in Table I which gives the change in inhours with the various substances which were placed in the cells.

Substance in cell	Inhours
#1 Al cans 19.0 grams	+ .34
#2 Al cans 19.0 grams	+ .35
#2 Al + 307.4 grams AGOT graphite	+ .37
#1 Al + 68.4 grams D_2O	+ 2.82
#1 Al + 11.33 grams Fe + 68.4 gm D_2O	- 6.12
#2 Al + 307.4 grams AGOT graphite	+ .58

The aluminum cans in which the heavy water was placed seem to be equivalent to the aluminum cans which were used in the graphite part of the experiment. The addition of the graphite produced only a small change in the inhours, due to the fact that the amount of graphite in the cell is very nearly optimum. The difference in the inhours between D_2O and graphite was 2.34. To interpret this result in terms of a cross section, an iron bolt was added to each cell. The change in inhours was -8.94. The cross section of an iron bolt for kT neutrons was found to be .278 cm^2 by comparison with Cd wires. These results show that the decrease in the capture cross section when D_2O was substituted was 0.0728 cm^2 per cell. Taking .00493 x 10^{-24} cm^2 for the cross section of AGOT graphite, the cross section of $\frac{1}{2}$ a molecule of D_2O is 0.0008 x 10^{-24} cm^2. These experiments show that heavy water is definitely superior to graphite as a slowing-down medium. On the other hand, it is to be emphasized that the results obtained for the capture of heavy water are subject to considerable error from several causes. Errors of 10% in the value of the cross section of graphite, the estimate of the slowing-down power of heavy water as compared with graphite and in the determination of the inhours are all fairly probable. For these reasons the probable error in the result is several times larger than the result itself. On the other hand, the contamination by ordinary water was about 19%, which would account for all the absorption observed. It may be concluded that while the above measurements do not establish an accurate value for the capture cross section of heavy water, they do indicate that is low enough to affect in only a minor way the design of heavy water plants. If the indication of such a low cross section is borne out, serious consideration should attend the possibility of a homogenous plant.