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CALCULATED AND OBSERVED P-10 PRODUCTION IN H-10

This document consists of 3 pages

Summary

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Recently three H-10 tubes (2772, 2176, 3673) have been removed from the H-10 and the tritium and other gases have been extracted from the Z slugs. It is of interest to compare the calculated volumes of gases with the amounts obtained in these extractions. The comparison is given in the table below:

Tube Number	Average volume of H^3 per Z slug in cm ³			Average volume of H^3 per Z slug in cm ³		
	Calculated	Observed	% less	Calculated	Observed	% less
2772	118.6	91.4	22.9	237.2	202	14.8
2176	95.2	76.2	20.0	190.4	157.5	17.3
3673	114.4	91.5	20.0	228.8	198.6	13.2

(The data for tubes 2176 and 3673 is not complete; only 3 slugs of the nine have been extracted for each tube. All nine slugs of tube 2772 have been extracted.)

- The reasons for the large disagreement are not known at present. As pointed out below, the weakest part of the calculation is our knowledge of the exposure which these Z slugs have received. It is possible that some losses, particularly of tritium, occur during exposure and extraction. In view of these uncertainties, it does not appear likely that more 25 has been burnt up per unit of tritium than has been previously estimated.

Method of Calculation

1. Exposure: The total energy liberated in each of these tubes has been estimated by W. Barnett; these estimates are believed to be correct to within $\pm 6\%$. The uncertainty in the exposure of the J and Z slugs arises in calculating the fraction of this total energy which is produced in the J-Z portion of the tube. Clearly this depends on the power distribution along the length of the tube. If one assumes a cosine for this distribution the result is that 0.538 of the power is produced by the nine J slugs. Some measurements of the distribution have been made by G. C. Fullmer; these lead to fractions of about 0.46. In this report we have used the value 0.48 since it is known that the measured distributions are not representative of the whole period of irradiation. For this reason also, we have calculated only the average volumes of gas per Z slug for each tube.

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2. Conversion Efficiency: The conversion efficiency (no. of H^3 atoms produced per 25 atom burnt up) is calculated to be $0.835 \pm 5\%$. (HW-17026).

3. Production of Tritium: Using the value of 203 Mev for the fission process energy and the above value for conversion efficiency we find that 1 mega watt day exposure in the H-10 charge yields 48.3 cc of tritium (Calculated and Checked To)

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4. Value of the ratio He^4/H^3 : The burnup of 25 in these tubes is about 6-7%; thus the value of the ratio: volume of He^4 - volume of H^3 should differ from 2 by only a few percent if we exclude a large capture cross section for H^3 .

5. Value of the ratio He^3/He^4 : This ratio has been calculated for the three tubes involved using a cross section of 5000 barns for the reaction $\text{He}^3(n,p)\text{H}^3$. The calculated values are in moderately good agreement with observed values as shown in the table below:

Tube Number	He^3/He^4 Calculated	He^3/He^4 Observed
2772	0.0125	0.015
2176	0.0105	0.012
3673	0.0120	0.014

Since a larger ratio is observed this may indicate that the cross section may be somewhat smaller than 5000 barns.

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