HALF-LIFE AND SPECIFIC ACTIVITY OF ^{99}Tc*

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ABSTRACT

The half-life and specific activity of ^{99}Tc were redetermined by measuring the activity of a known weight (determined coulometrically) of ^{99}Tc by a liquid scintillation method and found to be $2.14(\pm 0.05) \times 10^5$ years and $3.75(\pm 0.11) \times 10^4$ dpm per μg respectively. These results are in excellent agreement with previous values.

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DISCLAIMER

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In recent years, liquid-scintillation methods for absolute beta counting have been reported from time to time [1-6] and have been used, in a few instances, to determine half-lives of long-lived isotopes (^{87}Rb,[2] ^{176}Lu[6]) by the specific activity method. We have examined a liquid-scintillation method in some detail and found that, using an extrapolation technique, 100% counting efficiency could be obtained for beta groups above 200 keV in energy, and that quenching agents had little or no bad effect. This work has been reported elsewhere[7]. We are now using this method to redetermine the half-lives of long-lived beta emitters.

EXPERIMENTAL

^{99}Tc Solutions

Two solutions containing approximately 1 mg and 5 mg of ^{99}Tc per ml were prepared by dissolving NH_4TcO_4 (available from the Oak Ridge National Laboratory in radiochemically pure form) in 0.1N H_2SO_4.

Chemical Analysis

Replicate samples from each solution were analyzed by a controlled-potential coulometric method developed at this laboratory[8].

Absolute Beta Counting

After appropriate dilution of the analyzed solutions, replicate 200 µl. samples were transferred to 20 ml of a dioxane-naphthalene liquid scintillator (200 g of naphthalene, 5 g PPO, and 0.1 g POPOP in 850 ml of dioxane) and the disintegration rate determined by an extrapolation method.(7) The Packard Tri-Carb Liquid Scintillation Spectrometer was used with a high voltage of 1200 volts and attenuator setting 4.

RESULTS AND DISCUSSION

The results of all these determinations are presented in Table I,

(Table I)

along with the calculated specific activity and half-life of ^{99}Tc. A comparison of the half-life determined in this work (2.14×10^5 years) with previously reported half-lives (Table II) shows that all three are

(Table II)

in excellent agreement. A different counting technique and an improved method for chemical analysis were employed here; therefore, we can conclude that the half-life of ^{99}Tc is reliably known.

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Table I. Specific Activity and Half-Life of ^{99}Tc

	Solution	
	1 mg/ml	5 mg/ml
Coulometric analysis, mg/ml	0.926	4.78
	.943	4.69
	.959	4.65
	.955	4.80
	.935	4.69
		4.80
	0.944 ± 0.015	4.74 ± 0.07
Dilution factor	1.6×10^{-3}	$2. \times 10^{-6}$
Liquid-Scintillation Counting, dpm ($\times 10^{-4}$)	5.75	3.54
	5.68	3.53
	5.75	3.51
	5.75	3.58
	5.74	3.50
	5.73 ± 0.03	3.53 ± 0.03
Specific activity, dpm per μg	$3.79(\pm 0.10) \times 10^{4}$	$3.72(\pm 0.12) \times 10^{4}$
Half-Life, years	$2.12(\pm 0.05) \times 10^{5}$	$2.15(\pm 0.05) \times 10^{5}$

Table II. Comparison of Half-Life Values of ^{99}Tc

Half-Life, years	Counting Technique	Reference
$2.12(\pm 0.04) \times 10^5$	$4\pi\beta$	9
$2.16(\pm 0.05) \times 10^5$	$4\pi\beta$	10
$2.14(\pm 0.05) \times 10^5$	liquid-scintillation	this work