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FURTHER CALIBRATION OF THE 10,000 CURIE COBALT-60 SOURCE

W. Davis, Jr.

ABSTRACT

This memo summarizes results of calibration of the nominal 10,000 curie cobalt-60 source with ceric sulfate solution in a tank of ~ 4 liter capacity. The tank and associated agitator were built for use in irradiating two phase solution systems, such as those encountered in the first cycle extinction section of a solvent extraction plant. Dose densities are approximately 2 watts/liter of 0.4 M H_2SO_4 solution.

INTRODUCTION

The purpose of this memo is to summarize additional data on calibration of the nominal 10,000 curie cobalt-60 source operated by the Chemical Technology Division. These calibrations were performed with ceric sulfate solutions in a glass tank in the West Cavity (1) of the facility for the purpose of providing a reactor (Fig. 1) in which up to 4 liters of one or more solutions could be irradiated and simultaneously agitated. A prototype glass tank, glass stirrer, and glass covered source capsule well were used since ceric sulfate solutions react rapidly with stainless steel, of which the test reactor is constructed (3).

Most of the experimental work of these calibrations was performed by E. Oxendine; analyses of ceric sulfate solutions were performed by members of L. C. Bate's group of the Analytical Chemistry Division.

RESULTS

Calibrations were performed with the source capsule in the position indicated in Fig. 1, corresponding to a ratchet pawl position of 66 (2). Initial ceric sulfate concentrations were 0.0126-0.0130 mmoles Ce(IV)/ml in 0.4 $\underline{M}$ H_2SO_4. Three calibrations were performed, one each with initial volumes of 3500, 2500, and 1500 ml of solution (Table 1). Several samples were taken from each solution during the 3 or 4 hour irradiation period for subsequent Ce(IV) analysis. Calculations of radiation density were made by use of equations previously reported (2).

The average radiation density decreases as the solution volume decreases (Table 1, Fig. 2). Since the average rate is only about 0.0036 watts/100 ml solution in the range 3500-1500 ml solution in the glass tank, this is not a critical variable.

Volumes in the stainless steel tank (Fig. 1) equivalent to those used in the glass tank are based on the geometry of the former (3) and measured heights of solution in the latter; i.e., the surface of 4110 ml of solution in the metal tank would be at the same elevation as 3500 ml of solution in the glass tank if both tanks were placed on the same plane.

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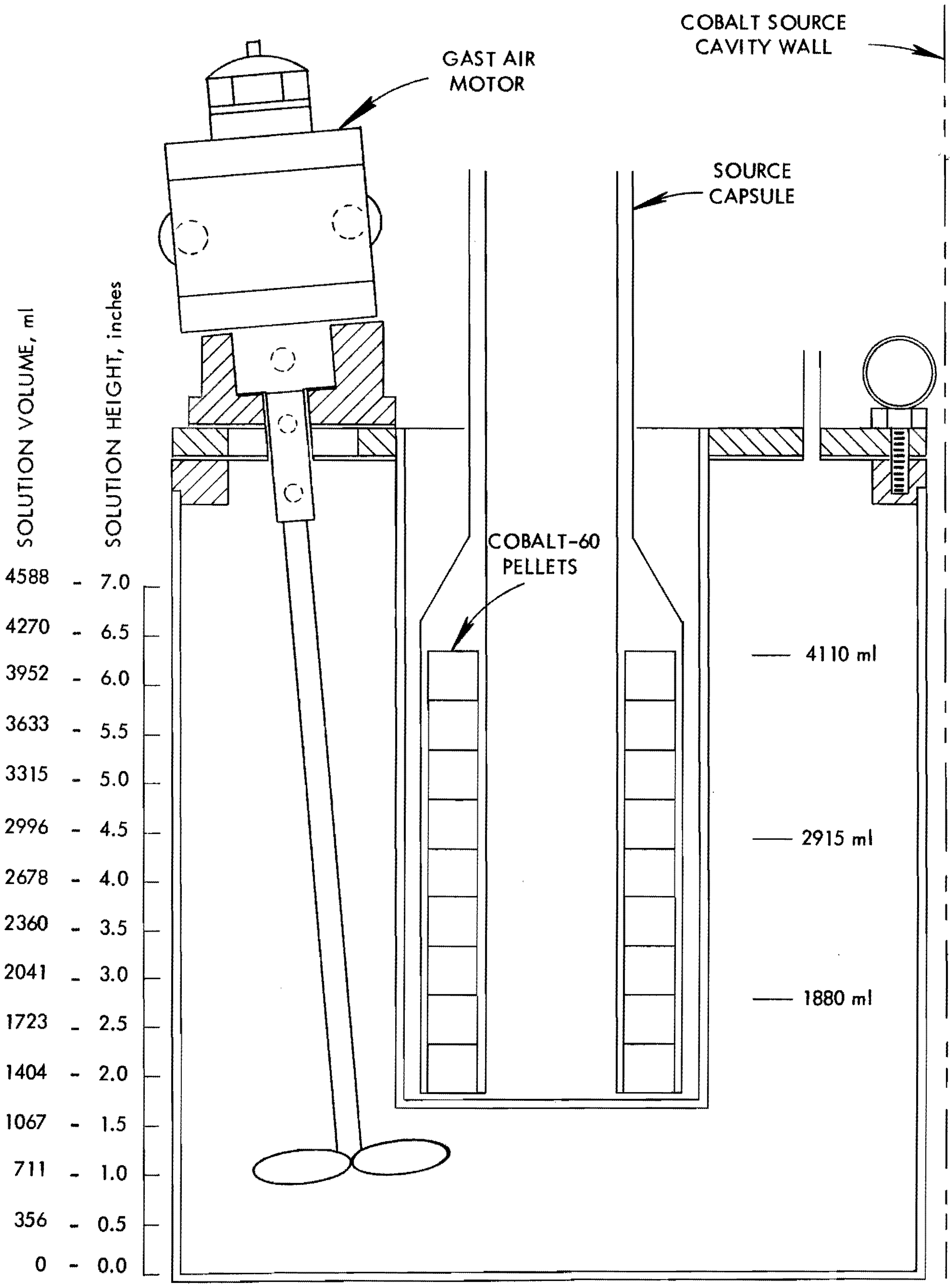

Fig. 1. Schematic of 4 liter Reactor-Agitator in Cobalt-60 Source Cavity.

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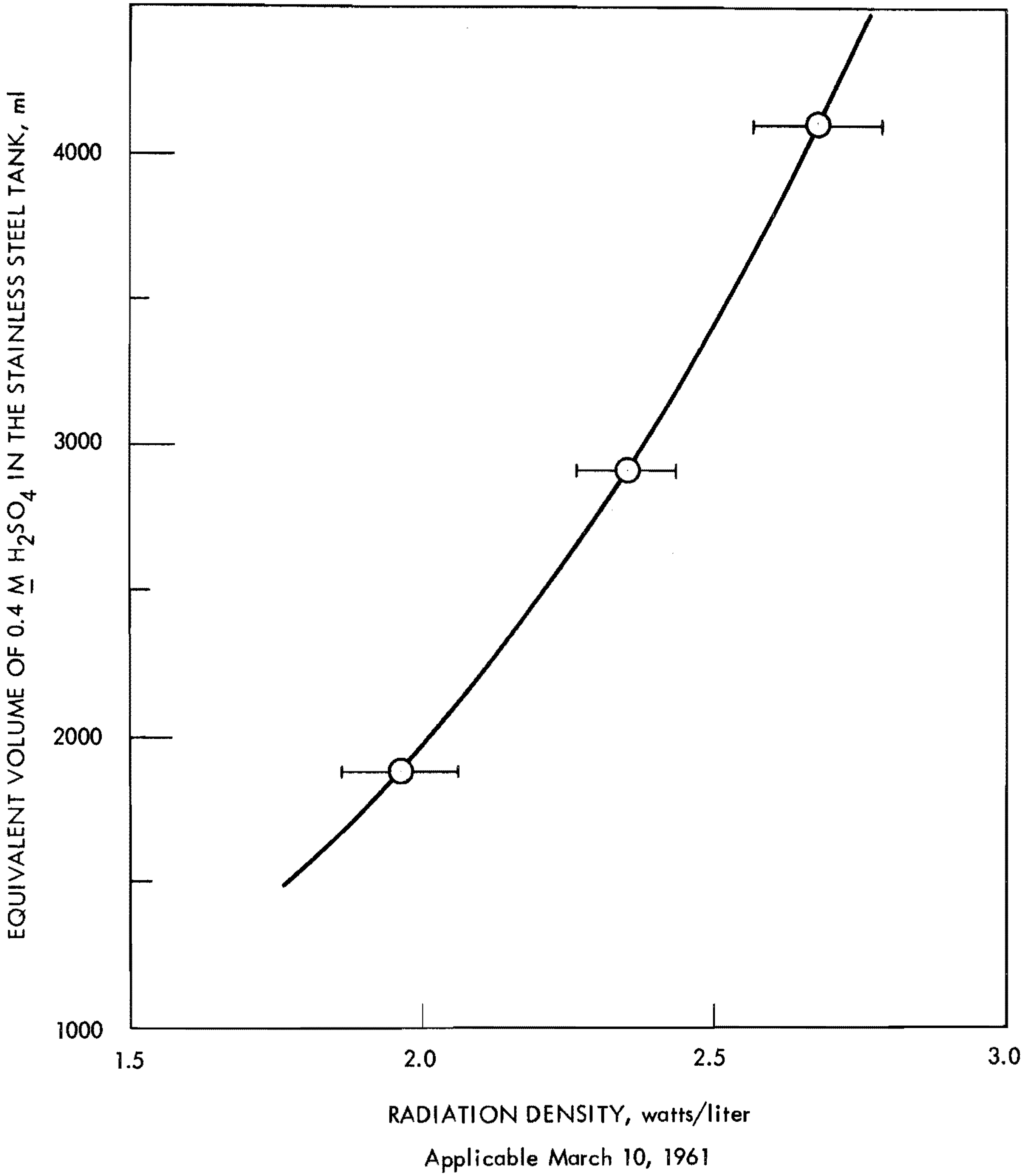

Fig. 2. Variation of average radiation density with total solution volume.

Table 1. Calibration of 10,000 Curie Cobalt-60 Source[a]

All data apply to March 10, 1961

Glass Tank Calibration Data						
		Radiation Density Based on 0.4 M H_2SO_4				Stainless Steel Tank, Equivalent Volume, ml[b]
		$\frac{ev}{min\text{-}ml} \times 10^{-18}$		$\frac{watts}{liter}$		
ml[b]	in.	Average	Standard Deviation	Average	Standard Deviation	
3500	6-1/4	1.003	0.040	2.68	0.11	4110
2500	4-3/8	0.882	0.032	2.35	0.09	2915
1500	2-3/4	0.734	0.039	1.96	0.10	1880

[a]Calibration with ~4 liter glass vessel, ~0.013 M $Ce(SO_4)_2$ in 0.4 M H_2SO_4.
The solution was agitated during irradiation and during sampling.
The source capsule was located at ratchet pawl position 66 (2); i.e., the bottom of the source capsule was ~2-1/4" above the bottom of the stationary shield cavity (1).

[b]Volumes are measured at room temperature.

REFERENCES

1. W. Davis, Jr., "The Chemical Technology Division, 10,000 Curie Cobalt-60 Source: Description, Operating Procedures, and Safety Procedures," ORNL-CF-60-3-82 (March 22, 1960).

2. W. Davis, Jr., "Calibration of the 10,000 Curie Cobalt-60 Source," ORNL-CF-60-11-29 (November 8, 1960).

3. ORNL-Dwg.-D-34148.

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