Fig. 1) consisting of an aluminum cup inverted over the end of the pipe that transports expired air to the valve. With each exhalation the cup rises until the ports in its sides open above the end of the pipe. The succeeding inhalation pulls the valve closed. The rubbing surfaces are machined to a close fit; a film of oil between the cup and the pipe insures a tight air seal. The valve is encased in an air-tight box.

A flap-type valve with aluminum frame and rubber diaphragm is used for the inspired air. Silverman and Lee (*1*) have recently described a similar valve and have given the reference sources.

Reference

1. SILVERMAN, L., and LEE, R. C. *Science*, 1946, **103**, 537.

Comparison of the Determination of the Disintegration Rate of Radiophosphorus by Absolute Beta Counting and Calorimetric Measurement[1]

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The quantitative measurement of radiophosphorus, P^{32} (14.3 days), is important in connection with clinical treatment and in connection with medical and biological research where the absolute quantity of beta radiation emitted by P^{32} must be known. Accordingly, it is desirable to be able to make quantitative measurements which are reasonably accurate. Up to the present, however, there has often been a great deal of uncertainty in the measurement of this material and, for that matter, in the measurement of many other radioisotopes. Curtiss (*1*) has recently pointed out that, in an interlaboratory comparison of measurements of I^{131}, deviations from the average by as much as 40–80% occurred.

We have had occasion to make a comparison of the determination of the disintegration rate of P^{32} by calorimetric measurement and by absolute beta counting and believe it is worth while to report these results in order to give an idea of the accuracy with which radiophosphorus can be measured.

The calorimeter used for the determination of the rate of heat evolution of radiophosphorus was of an isothermal type operating at the temperature of liquid nitrogen and using the rate of evaporation of nitrogen at constant pressure as the measure of the rate of heat input. A calibration of the calorimeter was made with a resistance heater at 5 points between the energy inputs of 0.2×10^{-4} and 2.5×10^{-4} watts. Mean deviation from the root mean square best straight line of rate of energy input versus nitrogen evolution was $\pm 0.8\%$. Time of equilibration in passing from one heat input to another was less than 30 min.

Absolute beta counting was done with an end-window G-M counter which was calibrated using several different isotopes Co^{60}, I^{131}, Au^{198}, RaE, Na^{24}, and UX_2) of known disintegration rate to determine the counter efficiency.[2] The disintegration rate of RaE was determined by making an absolute alpha count of RaF, which grows in as RaE decays. The disintegration rate of an equilibrium UX_1–UX_2 mixture carried from a solution of aged uranium was calculated from the known disintegration rate of the uranium. Disintegration rates of Co^{60}, I^{131}, Au^{198}, and Na^{24} were determined using coincidence counting technique.

A carrier-free sample of P^{32} prepared by the (n,p) reaction with S^{32} of an activity of approximately 25 mc was placed in the calorimeter and the energy output determined. Making a 1.3% correction for loss of beta-particle energy, which escaped the calorimeter as Bremsstrahlung, the sample measured $8.58 \pm 0.11 \times 10^{-5}$ watts at a given reference time.

A similar P^{32} sample was analyzed in a thin lens-type beta-ray spectrometer using a 50-μg/cm² source mounting. Under these conditions the Kurie plot was straight from the maximum energy to ca. 100 kv, where the absorption in the counter window could no longer be neglected. Assuming the Kurie plot to be straight below this energy, P^{32} was found to have an average energy of 0.700 Mev. This value of the average energy combined with the wattage determined calorimetrically gave a disintegration rate of $7.73 \pm 0.10 \times 10^8$ d/s at the reference time.

Absolute beta counts were made of 8 different aliquots of the P^{32} solution. A 1.3% correction for backscattering from the 2.5 mg/cm² polystyrene film on which the P^{32} aliquots were mounted for beta counting was made. The determinations showed a standard deviation of 2.1% with a value of $7.90 \pm 0.17 \times 10^8$ d/s at the reference time.

The rates of disintegration of two aliquots of the P^{32} solution were also determined by beta counting, using a National Bureau of Standards RaD + E beta-ray standard and following the procedure recommended by the Bureau. The two determinations gave disintegration rates of 7.64×10^8 and 7.83×10^8 d/s, respectively, at the reference time.

The disintegration rates determined by the calorimetric method, the use of a calibrated G-M tube, and the use of a National Bureau of Standards RaD + E beta-ray standard all agree within experimental uncertainty. The results indicate that, using thin, end-window G-M counter tubes with proper technique, the disintegration rate of P^{32} may be determined with a probable error of no more than 2 or 3%.

Reference

1. CURTISS, L. F. *Science*, 1947, **106**, 302.

[1] This document is based on work performed under Contract No. W-35-058-eng-71 for the Atomic Energy Project at the Clinton Laboratories.

[2] Reported in a paper, "Absolute Beta Counting Using End-Window Geiger-Müller Counter Tubes," by L. R. Zumwalt, presented at the September 1947 meeting of the American Chemical Society, New York City.