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ABSTRACT

1. The vapor pressure of postum is given by

\[
\log p = - \frac{5431.7}{T} + 40.2 + 7.3066 \pm 0.0403.
\]

At 850°C, postum vapor has 1.47 atoms per molecule.

2. Construction of apparatus for measuring vapor pressure by effusion has continued.

3. A determination of the purity of a sample of postum by the vacuum balance method gave 106.9 per cent. This high value is believed to result from faulty technique.


5. Experiments on the Hanson counter have been run in two different size rooms to determine the effect of scattering.
Preparation of a postum sample as a gamma standard has been started. Thirty-nine neutron sources and two gamma sources have been counted.

6. A sample of $\text{ThO}_2$ was compared with $\text{QO}_2$. Its pattern was very similar to that of the cubic form of $\text{QO}_2$. Two samples of $\text{ThBr}_4$ and one of $\text{ThOBr}_2$ were submitted for comparison with the pattern of $\text{QBr}_4$. The $\text{ThBr}_4$ contained enough impurities to make any comparison uncertain. A sample of $\text{QO}_2$ prepared by decomposition of the nitrate behaved exactly like those samples prepared by oxidation of the element. A sample of elemental postum has been received and a study of the change of lattice parameter with time has been started. The calibration of the X-ray cameras has been completed.

DETAILED REPORT


The data reported in August, 1948 and April, 1948 were compiled and a least squares determination was made by Miss Anita Geiger. Using the data of April 9 and 10, 1948, and August 25, 26, and 27, 1948, the following representation for the vapor pressure of postum was computed:

$$\log p = -\frac{2431.7 \pm 40.2}{T} + 7.3066 \pm 0.0403.$$

In the August run it was observed that above about 800°C, the pressure deviated from the vapor pressure equation because an insufficient amount of postum had been canned. The pressure was measured at 850°C.; and by computing the volume of the gauge, and the amount of postum present the molecular density of postum gas was determined assuming the ideal gas laws. This calculation gives 1.47 atoms per molecule, or at 850°C, about as many postum atoms as $\text{Q}_2$ molecules, assuming no molecules of higher order are present.

A new gauge has been constructed to study the vapor pressure of postum over long periods of time. It is desired to study the formation of $\text{PbQ}$, to determine how it combines with postum in the liquid state, and possibly to determine the vapor pressure of $\text{PbQ}$.

2. Vapor Pressure of Postum by the Effusion Method - L. G. Fauble, l.

Construction of apparatus is nearly complete. It is believed that a run will be possible during the next month at which time a complete description of methods, apparatus, and calculations will be made.
A third purity run was made on September 8, 1948 (refer to the Physics Group Progress Report for the period February 16-29, 1948, MIM-65, for runs #1 and #2). The experimental procedure used for the present determination was outlined in the Physics Group Progress Report for the period May 1-31, 1948, MIM-112, and is outlined below.

1. Place postum to be assayed in a quartz tube of the following size and shape:

   ![Diagram of a quartz tube](image)

   Bubble with thin end portion, Point A.

2. Calorimeter the tube for the quantity of postum, accurate to .1 per cent.

3. Weigh tube on a microbalance (Ainsworth) in an evacuated case.

4. Allow a small hole to be pushed through at point A by fusing thin end with a microflame in a nitrogen atmosphere.

5. Place tube inside quartz tube, which can be placed on vacuum line, and evacuate.

6. Distill postum out of weighing tube onto walls of containing tube at temperature high enough to distill out lead.

7. Remove empty weighing tube and reweigh on evacuated microbalance.

8. Recalorimeter empty weighing tube to determine if all of the postum was removed during distillation.

The purity determined by this purity run was 106.9 per cent postum. There were several difficulties encountered during this purity experiment which would account for part if not all of the error in the calculated result. The entire procedure should have been followed in not more than one week's time.
In the present case steps one and two were made and the tube containing the activity was then used in tests to determine the accuracy of weighing of the vacuum balance. Steps 3 and 4 were performed nearly sixty days later. Calculation shows that there should be about .6 atmosphere of helium present from the postum disintegration. This helium pressure was great enough so that the thin end of the quartz tube did not push in much, and even prolonged heating had negligible effect. During this heating the end of the microflame nozzle touched the quartz weighing tube and some material transfer probably occurred. The quartz was finally punctured with a sharpened tungsten rod.

There was about .009 case left in the weighing tube in step 8.

A fourth purity run is to be attempted in the near future.

4. Electrical Resistance of Postum - H. C. Morgan, 0.

No progress to report.


During the period of this report, measurements of neutron strength were made on fourteen sources for the Electrodeposition Group and on twenty-five sources for the Neutron Source Group. Gamma measurements on two sources were made for the Electrodeposition Group.

The experiments for the collection of inverse square data were repeated in this laboratory, C-3, and in a much larger space in order to study the effect on the response of the Hanson counting system by scattering from the surroundings. The data were fitted to an equation of the form

\[ y = k (b + x)^{-2} + s, \]

where \( s \) represents the number of counts per second coming from scattered neutrons. These experiments have been reported in a paper by Dr. H. P. Eneas to be presented at the Atomic Energy Commission Information Meeting at Chicago, October 18, 19, and 20, 1943.

A gamma source is being prepared for use in calibrating the lead geometry for gamma counting. It will consist of approximately twelve cases of postum in a quartz capillary, 6 in. long with a crossbar 1.6 cm. in length. It is planned that the activity will be concentrated in the crossbar for calibration and later uniformly distributed to test our attempt to produce a gamma counter which has a response independent of the distribution of activity.

The pattern of a ThO₂ sample indicated that the compound has the same structure as the cubic form of QO₂. The lattice constants are practically the same with the ThO₂ unit cell being less than one-half of one per cent smaller than the unit cell of QO₂. Hence, within the limits of accuracy of the measurements the ionic radii of Th⁺⁴ and Q⁺⁴ are identical.

The two samples of ThBr₄ which were received were not the same. By comparison of the patterns it was deduced that one sample contained at least two compounds and the other at least three. Although some of the lines were very close to lines of QBr₄ pattern, extra lines in both patterns made an exact identity impossible. The ThOBr₂ pattern was very faint indicating that the sample may contain mostly amorphous material.

A sample of QO₂ prepared by decomposition of the nitrate was exactly the same as samples prepared by oxidation of the element except that the sample prepared from the nitrate was apparently of higher purity.

Patterns are being obtained from a sample of elemental postum for the purpose of studying the change in lattice constant as the sample decays.

The calibration of the X-ray cameras has been completed. The results indicate that with samples of the most favorable size, density, particle size, etc., the accuracy of measuring lattice constants is better than 0.1 per cent.