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INVESTIGATION OF PLUTONIUM HYDRIDE

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PUBLICLY RELEASABLE

Per M. Sandover FSS-16 Date: 9-21-88

By M. Dallegio CIC-14 Date: 8/13/96

Attempts have been made to prepare plutonium hydride from three different samples of plutonium metal. The first sample did not form hydride. This report gives the results from two later runs.

Experimental Procedure

The specimen is contained in a small pyrex reaction chamber, which is held in a furnace. The reaction chamber is connected to a vacuum line which contains a gas burette, a manometer, and a container of UH_3 to supply hydrogen. The whole system is evacuated, and then hydrogen is admitted to the reaction chamber. Absorption of hydrogen by the sample is followed with the gas burette, and the P-T relationship can be determined by heating the reaction chamber and measuring the hydrogen pressure with the manometer.

Formula of the Compound

Specimen number 1540 - Forty-five mg of plutonium were charged into the reaction chamber. The specimen absorbed 7.65 cc of hydrogen at 585 mm pressure and $24^\circ C$. This corresponds to a formula of $PuH_{2.55}$. Hydro-

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gen absorption did not start immediately at room temperature, but did start and proceed rapidly at 50° C.

Specimen number 1541 - The sample weighed 82.9 mg and absorbed 15.1 cc of hydrogen at 584.4 mm pressure and 24° C. This corresponds to a formula of $\text{PuH}_{2.75}$. Hydrogen absorption started at room temperature after an incubation period of three minutes. Absorption was rapid and the reaction was complete six minutes after it started.

Decomposition Pressure vs. Temperature Curves

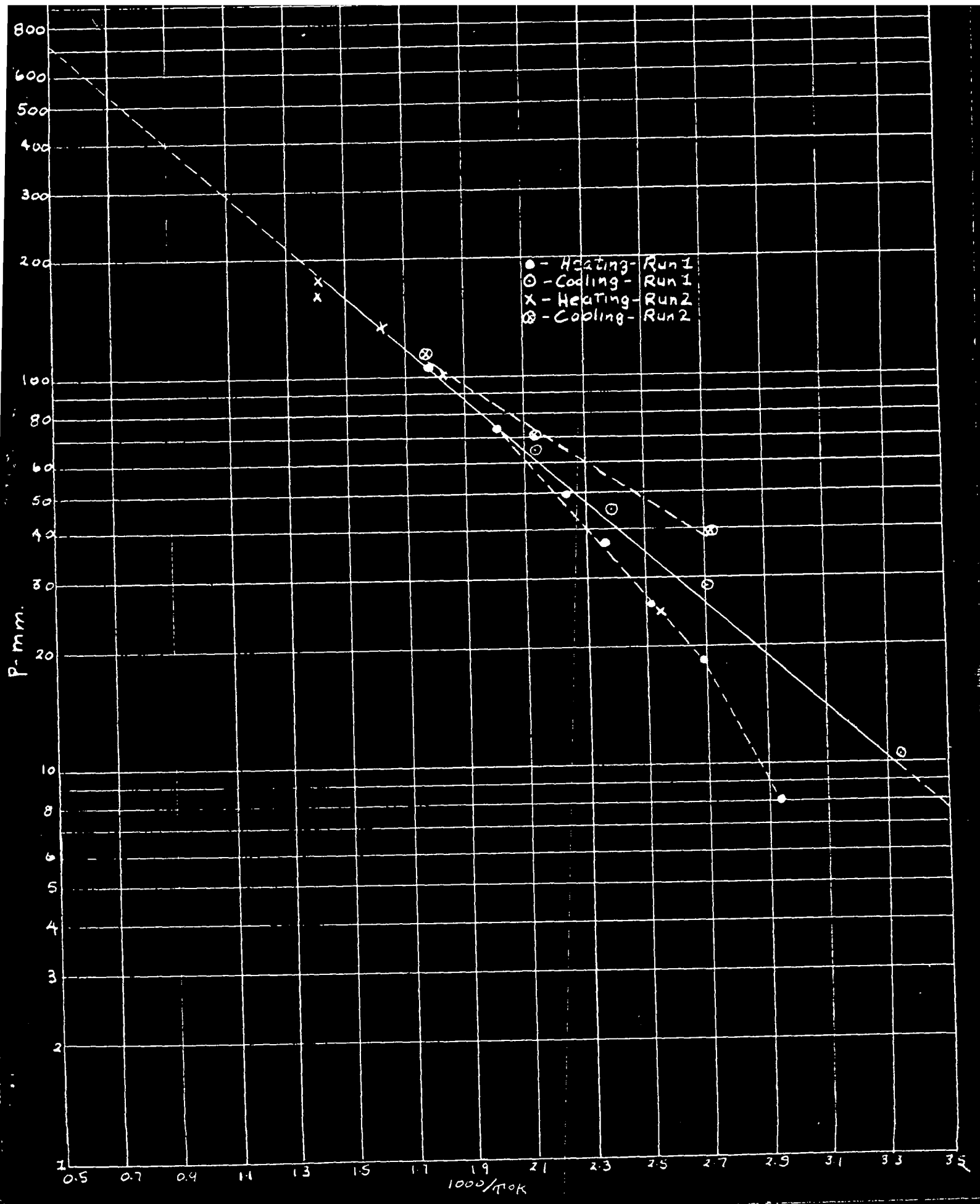
The data for this curve are more uncertain than the data for the composition. The system behaves very sluggishly and the hysteresis between the apparent equilibrium when approached from the high pressure side and when approached from the low pressure side is great.

The data from sample number 1541 are more trustworthy than those from sample number 1540, so the former data are plotted in Fig. 1. Sample number 1540 acted in a very sluggish fashion and it was difficult to get any reabsorption of gas upon cooling. In specimen number 1541, the reaction was definitely reversible, as shown by the cooling curves given in Fig. 1.

From the slope of this curve, for the reaction $\text{Pu} + 3/2\text{H}_2 \rightarrow \text{PuH}_3$, $\Delta H = -1420$ calories. By extrapolation, the temperature at which the hydrogen pressure equals 760 mm is about 1800° C. At 580 mm the temperature is about 1000° C and at room temperature the extrapolated pressure is 8 mm.

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