

[CONTRIBUTION FROM THE PACIFIC EXPERIMENT STATION, BUREAU OF MINES, UNITED STATES DEPARTMENT OF THE INTERIOR, AT THE UNIVERSITY OF CALIFORNIA]

The Heat Capacity of Lead Sulfate at Low Temperatures¹

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This investigation was undertaken primarily to furnish specific heat and entropy data of lead sulfate for use in the application of thermodynamic data on metallurgically important compounds of lead and the antimony-group metals.³

The methods, apparatus and accuracy have been described previously.⁴

Material

The sample used was Kahlbaum highest quality lead sulfate, and it contained no detectable impurities. It was dried for twenty-four hours at 114°. The material was in the form of powder, which was compressed into pellets in the usual manner. Calorimetric measurements were made on 313.6 g.

The Specific Heats

No previous low-temperature measurements have been made on lead sulfate. The results obtained in this Laboratory on the heat capacity of lead sulfate, expressed in gram calories (15°) per gram formula weight, are shown graphically in Fig. 1. The experimental determinations of the heat capacity are given in Table I. The calculations were made on the basis of Pb = 207.20, S = 32.06 and O = 16.00.

TABLE I
HEAT CAPACITY PER GRAM FORMULA WEIGHT OF LEAD SULFATE

T, °K.	C _p	T, °K.	C _p	T, °K.	C _p
53.8	9.810	142.3	17.54	244.7	23.07
58.2	10.26	161.8	18.68	260.5	23.71
76.9	12.57	185.3	19.71	272.8	24.36
88.0	13.61	208.1	21.18	273.5	24.35
99.9	14.61	237.6	22.66	282.2	24.62
116.9	15.91			293.1	24.83

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(3) Maier, U. S. Bur. Mines R. I. 3262 (1934).

(4) Anderson, THIS JOURNAL, **52**, 2296, 2712 (1930); **54**, 107 (1932); **55**, 3621 (1933).

Calculation of the Entropy

The entropy was calculated by the usual graphical method. The experimental heat-capacity curve coincided at low temperatures with a Debye function having the parameter $\theta = 112$. The

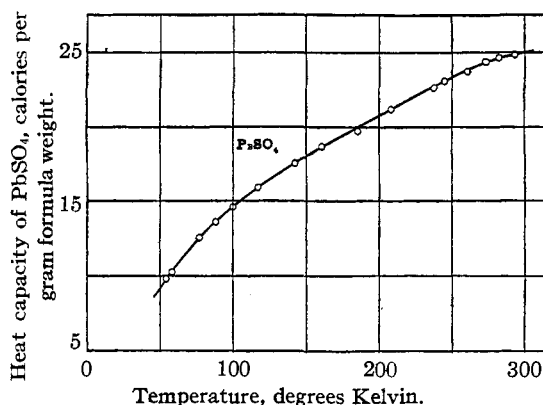


Fig. 1.—The heat capacity of lead sulfate, in calories per gram formula weight.

following combination of Debye and Einstein functions was found to fit the experimental data to about 200°K.

$$C_{PbSO_4} = D \frac{(112)}{T} + 2D \frac{(262)}{T} + 2E \frac{(774)}{T}$$

The results of the entropy calculations are given in Table II.

TABLE II ENTROPY DATA ON LEAD SULFATE	
Extrapolated (0–56.2)°K.	6.75
Graphical (56.2–298.1)°K.	28.45
$S_{298.1}$ graphical	35.2 ± 0.8
$S_{298.1}$ calculated from functions	35.0

The related thermal data have been discussed in the Report of Investigations.

Summary

The heat capacity of lead sulfate from about 55 to 300°K. has been determined and its entropy calculated as 35.2.

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