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THERMODYNAMIC INVESTIGATION OF
ALKALI METAL MIXTURES.

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THERMODYNAMIC INVESTIGATION OF
ALKALI METAL MIXTURES

Copies of three manuscripts that are to be submitted for publication are attached to this report. A summary of these papers, which cover the major accomplishments of the project to date, and a brief progress report on the other studies that are still underway follow:

(1) We have made full use of high precision thermometry, pure materials, and modern vacuum/argon dry-box facilities to measure in detail the solid-liquid phase equilibria diagrams of the (a) Na-K and (b) Na-Rb systems at one atmosphere pressure. The results are detailed in two of the manuscripts which are attached. The data are estimated to be accurate to 0.1°K in temperature and 0.1% in composition, accurate enough to have value for thermodynamic applications.

The new data result in significant corrections to the old measurements in both systems; but especially is this true in the Na-Rb system, which was found to be in error by as much as 25°K on the Rb-rich side of the diagram.

A sizeable error in the generally accepted value for the melting point of pure potassium has been detected.

Areas of solid solutions and limits of these regions have been carefully outlined in the Na-K system.

A careful search for intermetallic compounds produced none other than the meritectically melting Na_2K compound.

(2) Progress has also been made in the theoretical aspects of the program. A quasi-lattice model has been used with success to correlate and

semi-quantitatively predict thermodynamic quantities of mixing of the alkali metals. Very good fits of heat of mixing vs. composition curves were achieved by assuming that the larger atom of a binary system occupies a multiple number of sites on the quasi-lattice. The values of the empirical constants are reasonably well in line with the physical significance assigned to them in the theory.

The heat of mixing study supplies all information necessary for a semi-quantitative calculation of all thermodynamic properties of mixing in these systems. The results of these calculations are detailed in one of the attached manuscripts.

(3) Some preliminary data on the effect of high pressure on the phase properties of alkali metal systems have been obtained. The experimental technique for encapsulating the samples and applying pressures of up to 75,000 atmospheres simultaneously with temperatures of up to 500°C. has been worked out. The temperature sensing and recording system has been designed and tested.

Exploratory measurements show interesting results of the effect of very high pressure on the peritectic and eutectic halts in the Na-K system. For example, at high enough pressures an inversion of the temperatures of the halts occurs. Considerably more work will be required before we can interpret what is occurring.

(4) Preliminary measurements on the ternary phase diagram of Na-K-Rb are currently underway.