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Mound Laboratory
Miamisburg, Ohio

June 8, 1960

MOUND LABORATORY-MONSANTO
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J. F. Eichelberger

Research

TRIP TO SAVANNAH RIVER PROJECT
June 1-3, 1960

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Standard Gas Mixtures

Discussions were held with D. G. Ebenhack, R. L. Piech, and R. E. Wilmer concerning the forthcoming shipment of a standard gaseous mixture of hydrogen isotopes. The probable shipping date is June 17, 1960. The mixture has been prepared and divided into three batches, each contained in standard twelve liter product containers. SRP is now analyzing these mixtures with the idea that both Mound and LASL will run analyses on the mixture they receive. If agreement between all three sites is satisfactory, then each site will keep its container and the mixtures will serve as standards. However, if there should be any disagreement, the containers will be exchanged and further tests run.

Prints of the type of connection used by SRP for these product containers were obtained and the fitting was explained by its designer, C. A. McDonald.

Comparison of Analysis Procedures

The methods of analysis as done by SRP and Mound were discussed with E. D. Welch. There are several differences in the methods used, occurring primarily in handling the contribution to the mass 2 and mass 3 peaks by the fractionation of HD, HT, D_2, DT, and T_2 by the electron beam. In the derivation of the equation used by Mound for determining HD, it was assumed that HD and DT fractionate equally into their respective ions of the form H^+, D^+, and T^+. On the other hand, SRP assumes that DT fractionates in a similar manner as HD, which according to Friedel and Sharkey, fractionates to form H^+ and D^+ in the ratio 0.82/1.13. They also assume that the total amount of fractionation of DT is equal to the total formation of D^+ ions from D_2. The mass spectrometers are calibrated weekly and the formation of D^+ from D_2 is determined as part of the calibration

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procedure. Thus, the D^+ from DT equals .82/1.95 times the D^+ from D_2 and the T^+ from DT equals 1.13/1.95 times the D^+ from D_2. The T^+ contribution from T_2 is found in one of two ways. If possible, it is measured directly. However, if fresh tritium is not available, the fractionation pattern is calculated using an empirically determined ratio between the T^+ from T_2 and the D^+ from D_2 along with the measured value of the D^+ from D_2.

A second difference lies in the relationships used to determine the amount of HT in a sample. Mound uses the equilibrium constant for the reaction:

$$HD + T_2 \leftrightharpoons HT + DT$$

where: $$K = \frac{(DT)(HT)}{(HD)(T_2)} = 1.74$$

Thus, the amount of HT is given by:

$$HT = 1.74(HD)\frac{(T_2)}{(DT)}$$

SRP, on the other hand, uses the ratio of the equilibrium constants for the reactions:

$$H_2 + T_2 \leftrightharpoons 2HT$$

$$H_2 + D_2 \leftrightharpoons 2HD$$

where: $$K = \frac{(HT)^2}{(HD)^2}\frac{(D_2)}{(T_2)} = .788$$

Thus, the amount of HT is given by:

$$HT = (HD)\sqrt{.788\,\frac{(T_2)}{(D_2)}}$$

Further investigation is necessary to determine the compatibility of these methods.

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Instrumentation

Several electronic innovations have been added to the CEC Model 620 mass spectrometers in operation at SRP. These were discussed with W. B. Wilmer who pointed out that the A.C. amplifier in the old type 620 mass spectrometers is very non-linear and that this might account for some of the indications that we have had in the past that the sensitivity factors are concentration dependent. He gave me a circuit diagram for an addition to the CEC Signal Simulator which they have used to check the linearity of their amplifiers.

Mass Spectrography of Solids

Discussions were also held with W. B. Hess and P. J. P. Chastagner on the mass spectrographic analysis of solids. The instrument in use at SRP (CEC Model 720) was demonstrated and its properties discussed. They suggested that a Vac-Ion type vacuum pump be considered for the new N.A.A. instrument which is on order.

A letter from F. D. Lonadier was delivered to R. N. Tetzlaff.

D. M. Scott

D. M. Scott

DMS:oa

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