AEC-NASA TECH BRIEF

Reaction Studied of Steam with Niobium and Tantalum

To determine the suitability of high melting metals for fabrication of equipment to be used in high-temperature steam environments, a study was made of the kinetics of the refractory metals, niobium and tantalum, with steam at elevated temperatures. An insight was also desired into the mechanisms of the reactions of steam with metals at high temperatures. The results of this study are reported in *Reaction of Flowing Steam with the Refractory Metals Niobium and Tantalum,* by Martin Kilpatrick and Stanley K. Lott, *Journal of the Less-Common Metals,* 8, (1965) p. 299–305. The report includes experimental procedures, apparatus, preparation of samples, results, and a comprehensive discussion of the experiment.

In the reactions of niobium and tantalum with flowing steam, the experimental method involves (1) passing steam over an inductively heated specimen of metal, (2) passing the products through a condenser to remove water, and (3) measuring the gas evolved at suitable time intervals in a gas burette.

It was found that niobium obeyed linear kinetics over the temperature range 1050° to 1500°C after a brief induction period; the oxide was identified as β-Nb_2O_5. Tantalum, however, followed a paralinear rate law at temperatures from 950° to 1300°C, with the initial parabolic rate of reaction being followed by transition to a linear rate.The parabolic portion can be represented by a linear Arrhenius plot, while the linear portion does not follow an Arrhenius relationship. Tantalum forms β-Ta_2O_5 and, as the transition to α-Ta_2O_5 takes place around 1300°C, the reaction becomes too rapid to measure.

Notes:

1. This information may be of interest to mechanical and reactor engineers concerned with the design of high-pressure steam or water systems.
2. Inquiries concerning this innovation may be directed to:

   Office of Industrial Cooperation
   Argonne National Laboratory
   9700 South Cass Avenue
   Argonne, Illinois 60439
   Reference: B68-10189

   Source: M. Kilpatrick and S. K. Lott
   Chemical Engineering Division
   (ARG-10051)

Patent status:

Inquiries about obtaining rights for commercial use of this innovation may be directed to:

Mr. George H. Lee, Chief
Chicago Patent Group
U.S. Atomic Energy Commission
Chicago Operations Office
9800 South Cass Avenue
Argonne, Illinois 60439

Category 03