OBSERVATIONS CONCERNING THE DETERMINATION OF POROSITY IN GRAPHITES*

by

James M. Dickinson

Los Alamos Scientific Laboratory

The University of California

Los Alamos, New Mexico

ABSTRACT

An examination of some of the factors involved in the interpretation of mercury porosimetry data has been undertaken. Particular emphasis has been placed on the possibility of damage to the pore structure of graphite during the measurement of its porosity and the consequential effect on the porosity measurement. Among the techniques used to investigate these effects were vapor pressure measurements, X-ray diffraction, metallography, helium pycnometry, and the repeated intrusion and removal of mercury from the same specimen. Vapor pressures measured using graphite specimens that had been intruded with mercury during a porosimetry run were many orders of magnitude lower than the vapor pressure of mercury indicating that the rate controlling process was due to the way the mercury was tied up in the graphite. In some graphites the volume of helium that could intrude the sample was much less than the volume of mercury that could intrude the sample indicating that under pressure the mercury was forcing its way into pores that might better be classified as inaccessible. While no single piece of evidence was conclusive, the sum of the evidence indicates that damage can and does occur during porosimetry and that such damage affects the results of the porosimetry run. It is concluded that the errors in porosimetry measurements due to the measurements are due to two main causes. These are the fracture of cellular walls separating pores and the elastic deformation of the graphite during mercury porosimetry.

In an effort to obtain a method of presenting porosity data in a quantitative manner, rather than graphically as is commonly done, calculations of porosity parameters have been made based upon small-particle statistics. Both a log-normal model and a non-functional model were used and comparative results are given. The data indicates that, while the log-normal model fits many systems in nature, it fails to fit most graphites, and that the non-functional model offers a more promising approach for many graphites. Using these methods of data treatment the porosity of a specimen can be fairly well defined using two or three statistical parameters, the total porosity and the accessible porosity. Data are presented for several commercial and experimental graphites.

*Work performed under the auspices of the United States Atomic Energy Commission.