APPARATUS FOR ELECTRICAL CONDUCTIVITY MEASUREMENTS OF CLAY PLUGS IN CORROSIVE GASES AND AT LOW TEMPERATURES

The apparatus described in this paper was developed because of the need to measure electrical conductivity through clay plugs at various relative pressures of NH₃. The objective of the measurements was to study electrical conductivities of clay systems in NH₃ atmosphere over similar relative pressure ranges as has been done in water vapor. Comparisons of ion mobility and activation energy for ion movement could then be made between the two solvents as well as interpretations as to the status of the exchangeable cations and the NH₃ itself. The apparatus could also be used to study the characteristics of other vapor-clay systems for similar purposes. In its construction, several points concerning the conductance cell, on the one hand, and the measuring device on the other, had to be kept in mind.

The conductance cell had to satisfy three major requirements: (a) Nonreactivity to NH₃, (b) vacuum tightness, and (c) operation at low temperature, near the boiling point of NH₃, in order to allow conductivity measurements at different relative pressures ranging from zero to one.

The measuring device had to be designed to reduce to a minimum two main sources of error arising when an ordinary bridge is used to measure low conductances: Capacitance effects, or electrode polarization depending on whether an alternating or a direct current bridge is used.

DESIGN

The Conductance Cell

The body of the conductance cell is machined out of nylon. It consists of four parts as shown by Fig. 1 and 2. The top A and the nylon tube D, the bottom B and the cylinder C are sealed together with epoxy resin (Versamid 125 and Genepoxy 190 at a ratio 1:1). The same mixture was used to coat the channels (2) for the platinum leads (3) (3') and the hole (12) containing the thermocouple. The top A and the cylinder C are tightened together by six screws (4), a rubber O-ring (5), coated with a thin film of vacuum grease insures vacuum tightness of the cell.

The bottom B contains six cylindrical compartments each of which constitutes in fact an independent conductance cell. The platinum electrodes (7) are sealed with ordinary cement to nylon pistons fitting exactly into the compartments. The top pistons (6) are fixed to the central core A; the bottom pistons (10) are mobile and glide in the cylindrical holes. Steel springs (11), coated with Desicote, press them against the samples (8), and insure good electrical contact between the electrodes and the clay pellets. Each compartment communicates with

![Diagram of the conductance cell](Fig. 1—Multicomartment nylon conductance cell. I. Vertical cut through the center of the assembled cell; II. View from beneath of part A; III. View from above of part B. A, central core and top; B, bottom; C, cylinder; D, nylon tube. (1) channel to vacuum system; (2) channels for leads coated with epoxy resin; (3), (3') platinum leads; (4) screws; (5) rubber O-ring; (6) fixed pistons; (7) platinum electrodes; (8) sample-pellets; (9) channels to the samples; (10) mobile pistons; (11) springs coated with Desicote; (12) hole for thermocouple.)