This concept was more widely recognized by researchers [e.g. Ethridge et al., (1979); Hench et al., (1980); Buckwalter et al., (1982); Oversby (1982); Pederson et al., (1983); Machiels and Pescatore (1983)] that the particle size of the leached materials and the volume of fluid that was available for the leaching process had a significant impact on the experimental results. Figure 6.3 demonstrates this dependence. Shown is the release of silica form a nuclear waste form as a function of time with control of the surface area to volume ratio.

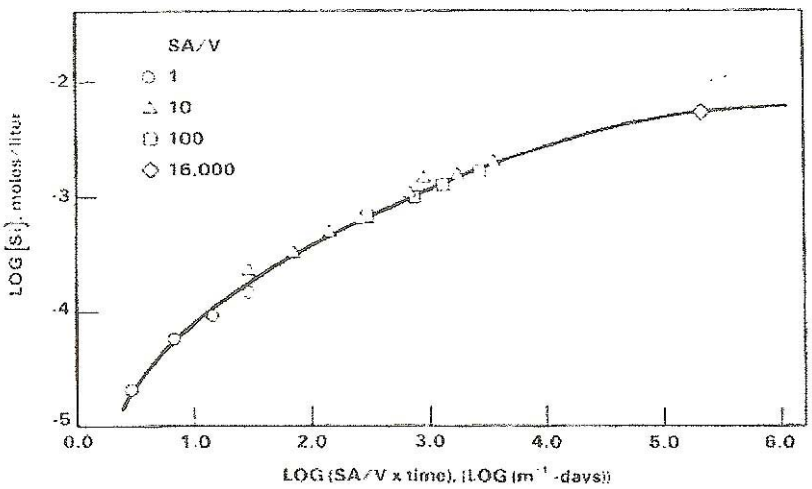

Figure 6.3. Log [Si] vs Log SA/V x t for a glassy nuclear waste form (after Pederson et al., 1983).

What is important in this figure is that by specifically including the surface area/volume parameter, leaching rates varying over 3 orders of magnitude can be scaled onto the same plot.

Measurement of Surface Area

The well established method for determining the surface area of a solid material is BET [Brunauer et al., (1938); Yates (1992)]. This method is a routine analytical approach to measure the accessible surface of the rock to N_2 gas molecules. In the analytical procedure, the rock specimen is heated to degas the surface in a heated vacuum cell. This step is followed by the introduction of gas back into the cell. The final step is to drive off the newly adsorbed gas and measure the quantity released. Knowing the volume of the gas and the molecular diameter of the particular gas, an accurate surface area can be calculated. Gases other than N_2 can be used but they would possess a different molecular size and thus a different quantity of gas would be needed to cover the same surface area. Therefore, it becomes necessary to specify the gas used in the measurement. Additional discussion of surface area measurements and their relationships to porosity and reaction kinetics is given by Brantley and Mellott (2000).

Although the technique is well established, instrumentation may not be readily available to most laboratories. To address this issue, some researchers have used a geometric surface area in place of the BET surface. If the solid materials being tested are glass, this approach may be acceptable, however, if the materials are rocks with irregular surface areas, this approach will significantly under estimate the areas.