INTRODUCTION TO CONCEPT OF PORE-SHAPE FACTOR FOR POROUS SPHERES IN THE STUDY OF EXTRACTION RATES

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ABSTRACT

In a liquid a satisfactory method of defining the diffusivity so that it will be independent of relative composition, has yet to be devised. The recent development of effective methods for the calculation of mass –transfer rates from particle surfaces, now brings forward the need of considering pore diameters, permeabilities and porosities. Knowledge of liquid diffusion rates in porous solids has applications in solid-liquid extraction and in catalysis. Piret E. L., Ebel R.A. Kiang C.T. Armstrong W. P. aimed to investigate about liquid diffusion rates which would be of value in the study of actual systems involving porous carrier solids and to obtain idealized extraction systems. In their work, they presented theoretical expressions and experimental data for extraction from single capillaries, from beds of uniform glass beads and from inert porous spheres carrying single-phase solutions of soluble substances. They introduced the concept of pore shape factor. Pore shape factor is equal to the ratio of the actual to the theoretical extraction time or for an actual sphere of measured radius R, an equivalent, idealized sphere of radius KR, $(K > 1.0)$ can be postulated, whose structure offers no resistance to diffusion. The square of this constant, K^2, will be called the pore shape factor. This factor is used in interpreting and correlating the extraction data. Here in this paper the author intends to interpret the results, obtained in their investigations and to derive a simple formula to determine this pore shape factor. For this purpose, Euler's Summation Formula and Abel's identity are applied to the analytic solutions obtained for their experiments. This approximation is obtained only for small values of $\frac{Dt}{R^2}$, where D is diffusivity, t is time and R is measured radius of sphere. The formula is verified for experimental data. It shows nice agreement with the experimental data.

KEYWORDS: Extraction, Pore Shape Factor, Euler's Summation Formula, Abel's Identity and Big oh Notation