(161) Slag-metal Reactions by Model Experiments

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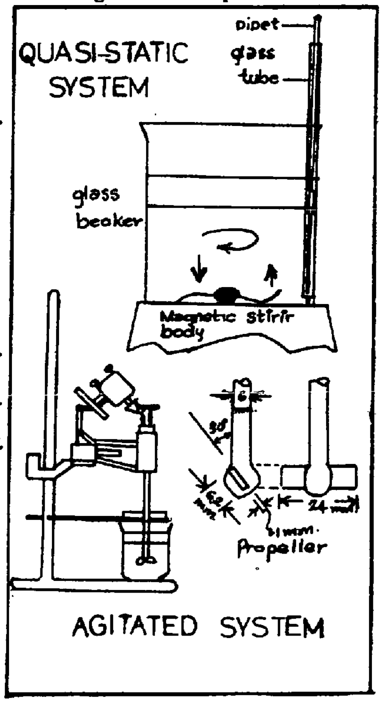
This paper is primarily concerned with the analogy between a metallurgical slag-metal system in which a simple displacement reaction takes place, and a geometrically similar low temperature system. The purpose is to study in a general way, the effect of the size and shape and the convection conditions upon the rates of such reactions. Two systems were employed: The quasi-static system and the agitated system.

The apparatus consisted of a magnetic stirrer with a variable speed lever (for the first system) a two bladed propeller connected to a variable speed motor driven agitator (for the second system.) Liquid parafin-kerosene oil mixture and dissolved phenol as the solute consisted the upper phase and a 5 % wt. sodium sulphate aqueous solution made up the lower phase. Samples were obtained by use of a pipet at the desired time interval. A colorimeter was utilized to analyze the phenol concentration.

Results obtained from the quasi-static system were analyzed with the aid of the " Two Film Theory ". The transfer coeffecient K and the flux N have been found to be independent of the interface area A, but dependent on the viscosity of the upper phase. (It was not feasible to vary the viscosity of the lower phase for both systems.) It should be stressed here that the results obtained provides only a qualitative description of the mass transfer in relation to the parameters considered here.

It has been found further that the " Two Film Theory " is not applicable to the agitated system largely due to the difficulty of obtaining the absolute value of the interfacial area, although, further experiments must be done in this connection to fully verify the findings of the present work. The method of dimensional analysis can provide an empirical relation which does not give account of the mechanism involved, but embraces the variables affecting the process in terms of dimensionless parameters. Evidently, in an agitated system the transfer coeffecient depends on the diffusivity D and the quantities making up the Reynolds Number and so forth. These quantities, if arranged in terms of dimensionless groups, and by virtue of the theorem of Buckingham gives the equation $\frac{\bar{n}}{\Delta C} = Const.\left(\frac{\mu L}{\nu}\right)^a \left(\frac{\nu}{D}\right)^b \left(\frac{\mu^2}{Lg}\right)^c \left(\frac{\rho L \mu^2}{\sigma}\right)^d \left(\frac{\nu_1}{\nu_2}\right)^e \left(\frac{\rho_1}{\rho_2}\right)^f$ where $\bar{n}$ is the rate of transport and the rest are those of the conventional nomenclature. Utilizing this theorem, it has been found that the general equation $B = const.\ \frac{d^{.44}\, D_2^{.5}\, (rpm)^{.72}}{\nu_1^{.72}\, \chi^{.22}} \left(\frac{D}{D_2}\right)^{.26} \left(\frac{\mu}{\mu_2}\right)^{-27} \left(\frac{\rho_1}{\rho_2}\right)^{-19.2}$ where: B= diffusion velocity, D_1 D_2= diffusivity in the upper and lower phases respectively, ν_1 = kinematic viscosity, upper phase, d=diameter of the vessel, may be used in correlaworks using a similar system such as the present work and using the value 0.5 for the Schmidt Number exponent.



Apparatus