"Air Oxidation Studies in a Long Graphite Channel"

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The studies of the air oxidation of short tubular specimens of graphite reported at the last Carbon Conference are now complete. In these experiments the conditions were so adjusted that there was no significant oxygen concentration gradient along the bore of the tube. An important practical extension to this work is the case where there is such a gradient along the major axis. This is the condition normally met with in long columns of graphite where the reagent is depleted as it flows through the column and there, therefore, exists both an axial and a radial concentration gradient. The present paper describes experiments carried out on such a column. The column was 14-ft high, 2-in I.D. and 4-in O.D. and was constructed from six sections of British pile grade graphite. The experimental techniques employed were similar to those previously reported. Thus, the graphite was exposed to air at its inner surface only and evidence of the radial diffusional effect was obtained from gas concentration measurements at the exterior surface. The reaction rates along the channel were determined from the bore oxygen concentration profile. This was obtained by means of gas probes inserted into the bore of the column. The experimental conditions used were such that the reaction was in the first transition region between chemical and in-pore diffusion control of the rate. This is the condition where the oxygen concentration at the exterior surface is finite but smaller than the free gas composition. Under these conditions despite the existence of the bore oxygen concentration profile no corresponding gradient at the exterior surface was observed. The previously derived diffusional theories were extended to cover this limiting case and these extensions allowed the diffusional effects to be quantitatively estimated. Good agreement between these results and previously reported values was always obtained.

The effect of bulk flow through the graphite on the observed reaction rate was studied. The effects were found to be considerable and an extension of the diffusion theory was used to explain the effect. Agreement between this extended theory and the practical results was quite good.

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