# OXIDATION OF BORONATED GRAPHITE*

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## ABSTRACT

The oxidation of two types of boronated graphite (nominally 5 weight per cent boron as $B_4C$) by 1 per cent oxygen in helium has been investigated over the temperature range 580 to 780°C. The two boronated graphites, which have been designated "black" and "grey", differ primarily in the distribution of the contained boron and in their specific surface area, the black material having about 3 times the specific surface area of the grey. In both cases, oxidation occurs by two competing reactions, namely

$$C + O_2 \rightarrow CO_2$$

and

$$B_4C + 4 O_2 \rightarrow CO_2 + 2 B_2O_3$$

As indicated by these equations, $CO_2$ is the only oxide of carbon formed in this temperature range. This result is in direct contrast to that obtained in the absence of boron, where both $CO_2$ and CO are formed at all temperatures.

As a function of time, the oxidation rate of the black boronated graphite increases initially and then levels off. For the grey boronated graphite, the oxidation rate exhibits a maximum. Both the initial increase in rate and the position of the maximum are temperature dependent, the former increasing more rapidly and the latter earlier at higher temperatures. In both cases, the initial increase presumably stems from the initial surface area increase. The occurrence of a maximum and the eventual decrease in rate for the grey material are attributed to the buildup of molten $B_2O_3$, which probably serves as a physical barrier to oxygen diffusion.

When the $B_2O_3$ formed during oxidation is removed from the sample by leaching in boiling water, a considerable increase in the subsequent oxidation rate is effected. In the case of the black boronated graphite, the rate versus time curve behaves much like that occurring before leaching. For the grey boronated graphite, however, the rate of oxidation following leaching continually decreases with the formation of new $B_2O_3$ without passing through the maximum exhibited during the initial rate measurements. When the samples are leached before any oxidation measurements are performed, essentially no significant effect on the rate is observed, indicating that little if any $B_2O_3$ is initially present in the samples.

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