

CHAPTER - I

I N T R O D U C T I O N

The oxidation of carbon is undoubtedly the most basic steelmaking reaction. It is important on several counts; it is the principal element controlling properties, and its control is of prime concern. Although the principal objective of the carbon oxygen reaction is to oxidise excess carbon, the accompanying boil should not be underrated. The mechanical agitation, stirring and mixing resulting from the boil are so useful in the distribution of heat and in promoting uniformity of composition in the bath that, were it not a natural consequence of the carbon-oxygen reaction, it is probable that something would have to be invented to replace it. From the physico-chemical viewpoint the reaction of carbon elimination is markedly different from other steelmaking reactions, in that it does not reach equilibrium at any time during the steelmaking processes. Although the carbon-oxidation reaction never attains equilibrium it promotes the rate of oxidation of other metalloids present in the bath, whose oxidation reactions normally proceed to equilibrium. This distinction makes it necessary to examine the kinetics of carbon-oxidation reaction. Metallurgists are also very much concerned with the speed of the carbon reaction, since

rate at which carbon is eliminated affords an indication of the way in which the heat is worked and latter determines the ultimate state of deoxidation and cleanliness of the steel.

Kinetics of oxidation of carbon in laboratory and industrial scale has been subjected to intensive investigation by a host of investigators. Shenck et al proposed a purely homogeneous reaction between carbon and oxygen, disregarding the other important phenomena in the heterogeneous gas-slag-metal interface. While Darken, Vallet, Watanabe, Larsen etc. have considered the rate-controlling mechanism as that of diffusion of oxygen in the bath to the dead reaction film of iron, investigations by Samarin and coworkers on the low-carbon ranges have supported the idea that rate controlling step is that of diffusion of carbon. Phillipov considering the process over both the high and low carbon ranges has forwarded a generalised theory, based on "Diffusion-kinetics" and has introduced the concept of the so-called "critical carbon concentration". At concentrations higher than this point, the rate of carbon-oxidation is controlled by diffusion of oxygen, while at concentrations lower than the critical carbon concentration, the rate is controlled by diffusion of carbon. Recent investigations by Fujii et al have also justified the existence of a "Transition point" where the mechanism changes. Activation energy values obtained by these investigators have varied between 20 - 34 Kcal. Normally, diffusion controlled

mechanisms indicate activation energy in the order of 10 - 15 Kcal. This would be particularly so, for processes occurring inside molten metals at high temperature, where mobility of atoms are expected to be high. Hence the postulate of a diffusion controlled mechanism supported by comparatively high activation energy value does not appear to be realistic.

The present investigation was taken up to study the effects if any, of factors like, surplus oxygen in the bath, ambient oxygen pressure in the gaseous phase, stirring of the bath, preferential adsorption of nitrogen on the reaction rate both at high and low-carbon ranges. After studying all these above factors on the rate of carbon-oxidation, a new mechanism has been proposed for this important reaction.