3.0 SCOPE OF THE PRESENT STUDY

The previous studies on the effect of inclusions on the formation and growth of cracks in steel are with respect to killed category. In Rourkela Steel Plant, the problem of edge-cracks in killed quality steels is very nominal. However, the incidence of edge cracks in semi-killed steels is quite common. Previous investigations have clearly shown that in rimming steels, the problem of edge cracks is due to the presence of rimholes, near the surface especially in the bottom one third of the ingot. Survey of the available literature indicates that the report on edge cracking in semikilled steels is sporadic and limited.

Semikilled steel is likely to have bad effects of inclusion as well as blowhole, since both are present in the ingot. It is impossible to obtain low inclusion count in the case of semikilled steels, since they have about 100 PPM of oxygen left even after deoxidation. Under normal pressure the reaction between oxygen and carbon to give carbon monoxide during solidification cannot lead to oxygen levels low enough to prevent the formation of oxide inclusions in semikilled steel.
A large proportion of the secondary inclusions formed would indeed remain in the ingot due to the unfavourable condition for their separation from the liquid steel. Such inclusions may well give rise to the development of cracks in semikilled steel also. On the other hand, it is likely that microvoids, even if they are present at the inclusion-matrix interface do not develop into macrocracks unless hard inclusions which are close to each other are present. If inclusions were the major cause for cracks, cracks should develop where the concentration of inclusion is highest. Therefore, a microscopic examination in the cracked portions would reveal to some degree inclusion-crack development relationship in semikilled steel. The microscopic examination is also useful to assess the importance of macrovoids in the form of blowholes.

The blowholes are likely to be close to each other when the degree of deoxidation is inadequate. Similar to the case of rimming steels, in the presence of tensile forces along the edges during rolling, edge serration may be caused. Therefore, deoxidation in semikilled steel is quite likely an important step and in this study, the effect of deoxidation on edge cracking in semi-
killed steels has been investigated. Hence the scope of the investigation is defined as follows:

(a) a study of the location of crack edges in hot rolled coils

(b) microstructural studies of crack edge samples

(c) study of the slab corner samples where tensile forces dominate during hot rolling

(d) optimisation of deoxidation methods, specially suited for low carbon semikilled steels in Rourkela Steel Plant

(e) preparation and study of suitable experimental ingots, and

(f) a thermodynamic modelling to arrive at the optimum composition of low carbon semi-killed steel.

3.1 Preliminary Studies

Preliminary studies were carried out to assess the relative importance of inclusions and blowholes in edge cracking so that experiments may be planned carefully. Our study on the crack edge coils showed that the defect
FIG. 5. Crack tip at the coil edge.
Sample condition = Unetched
Magnification = x 100

FIG. 6. Crack tip at the coil edge.
Sample condition = Unetched
Magnification = x 100
FIG. 7. Crack tip at the coil edge.
Sample condition = Unetched
Magnification = x 100
arose in the inner laps of the coil which correspond to the top portion of the ingot. A preliminary microstructural study also showed that the steel was fairly clean at the cracked portions of the coil and crack tips were devoid of inclusions as shown in Figs. 5-7. It must, however, be pointed out that major part of the project was carried out in steel plant with a scheduled production and there were a few constraints limiting large scale experimentation. The number of ingot and slab samples had to be necessarily limited and such constraints are perhaps more common in this area of research.