Conclusions

- Blistering occurs when oxide scale is swollen during oxidation; generating a critical stress and gas release at the scale/steelface interface.
- Blistered scale causes surface defect problems when it is rolled, becoming embedded into the steel.
- It is important to understand the mechanism of blistering and control the blister formation in order to prevent surface defects.
- Severe blistering has been found to occur in temperatures between 950 and 1000°C.

Nucleation and growth modes were investigated in order to understand the mechanism of blister formation.

Investigation

- Stress crack between oxide and substrate
- Complex spinel layer growing upwards
- Oxygen diffusion path
- Stress incompatibility between phases
- Growth follows oxygen path
- Oxidation decomposition
- Steel surface has undergone oxidation within the blister after detachment of the oxide

Fig 2 – Blister curve of a HSi
Mode 1 – Incubation time for blistering formation accelerated by rises in temperature and/or time.
Mode 2 (Not present) – Incubation time for blistering formation decreased by rises in temperature due to increased ductility within oxide scale

Fig 3 – Oxide morphology
Fig 4 – Oxide stress paths
Fig 5 – Fracture plane
Fig 6 – Blister
Fig 7 – Dendritic oxide growth
Fig 8 – Oxidation product phase analysis on 3.2wt% Si steel

1. Scale morphology will influence surface strip quality, work roll wear and removability of the scale.
2. The SEM and EDS oxide scale characterisation show a complex spinel morphology of fayalite penetrating into the underlaying steel matrix.
3. The penetrating fayalite oxide makes scale removal highly difficult
4. Oxidation can be seen within the blisters