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REVIEW ON EFFECT OF STRAIN RATE ON MICROSTRUCTURE AND FAILURE BEHAVIOUR OF 18-8 AUSTENITIC STAINLESS STEEL

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ABSTRACT

AISI 304 austenitic stainless steel containing ˜18 wt. % Cr and 8 wt. % Ni, commonly termed as 18-8 stainless steel is a popular choice as the material for protection against corrosion, oxidation and creep in process industries. However, strain rate during processing has a pronounced effect on the tensile behaviour, fracture characteristics and corrosion resistance of the formed component. The effect of strain rate is manifested at microstructural level in altered deformation mechanisms. At slower strain rates such as 10-4 s -1 , there is extensive TRIP effect, that is deformation induced austenite-to-martensite phase transformation leading to enhanced tensile strength and ductility. In contrast, faster strain rates like 10-1 s -1 and above, limits the TRIP effect and deformation mechanism is predominantly through twinning and slip with reduced tensile strength and ductility. These interesting behaviour has been rationalized on the basis of macroscopic observations like measurements of specimen's temperature during tensile testing and quantification of microscopic features such as dislocation density, twin fraction, extent of martensite formation and dimple size and distribution analysis. Furthermore, in this review, an attempt has been made to account for contradictory reports on the effect of strain and strain rate on corrosion resistance of this steel. Finally, areas for future research have been put forward to advance the existing knowledge base.

Keywords: austenitic stainless steel, deformation induced martensite, dislocation density, twinning, corrosion resistance