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## **Abstract**

Ferritic weld metal was deposited with gas shielded flux cored arc welding (FCAW-G) process. The nitrogen level in the deposited weld metal varies typically between 20 to 100 ppm. Nitrogen is a fast diffusing solute element that is known to cause strain ageing affecting both strength and toughness. Weld metal was produced with intentional additions of two strong nitride formers, titanium and vanadium. All-weld metal tensile samples were subjected to varying levels of strain, aged at 170°C for 20 minutes and reloaded to failure. Both the yield and tensile strength increased with increase in pre-strain confirming the presence of strain ageing. The strain hardening rate is also seen to change with strain ageing. There is also a corresponding decrease in the uniform elongation with increase in nitrogen and prestrain. The effect of strain ageing treatment on weld metal toughness was also evaluated. A nominal 2%-3% strain was imposed on the weld metal by straining it in the direction of welding and Charpy V-Notch toughness of the weld was measured. The ductile to brittle transition temperature (DBTT) of the weld metal was estimated by measuring the percent shear and the weld metal toughness at different temperatures. The DBTT of the weld metal is seen to shift slightly to higher temperatures with increase in pre-strain. However there was a dramatic drop in the upper shelf energy and a consistent decrease in the average toughness of the weld metal at all temperatures. The as-welded and reheat microstructure of the weld metal was characterized using optical and electron microscopy techniques. The possible implications of strain ageing on pipeline girth weld procedure qualification and in service integrity are discussed.

## **Keywords**

Weld metal, Strain ageing, Charpy energy, Weld strength