Abstract

Wear behaviour of a few plain carbon steels in unstrained and pre-strained conditions, and a weld joint of low carbon-manganese steel have been studied. Tensile pre-strain levels within the range of uniform elongation have been imposed in several specimen-blanks of the plain carbon steels, from which hardness, tensile and wear specimens have been fabricated. Effect of pre-strain on tensile properties and hardness was studied to supplement the wear studies. To estimate the transition load between mild and severe wear a series of wear tests were carried out for the steels, and base metal of the weld joint. The loads corresponding to severe wear regime have been considered for wear tests on the pre-strained and weld specimens of the selected steels.

Studies on wear behaviour of the pre-strained steels revealed that wear rate increases with increasing pre-strain up to some critical value and then it drops with further increase in pre-strain. It has been observed that the magnitude of the critical pre-strains of the selected steels changes with the nature and amount of the microstructural constituents, and varies in a narrow range of critical pre-strain of 0.73±0.07 for hypo-eutectoid steels, when pre-strain normalized with respect to maximum uniform strain. Beyond the critical pre-strain value, the relative drop in wear rate has been observed to be higher in plain carbon steels containing more than 0.4 wt% Carbon. This has been explained with distribution of ferrite and pearlite in the microstructure of the investigated steels. Hardness and tensile strength of the steels increase monotonically with increase in pre-strain as expected, but wear rate also increases up to the critical pre-strain, which is contradictory to Archard's proposition. The phenomena of nucleation of voids or micro-cracks, and their subsequent rapid propagation are believed to be the governing factors for the deterioration of wear resistance of the pre-strained steels up to their critical pre-strain.

Studies on wear behaviour of weld joint have demonstrated that the parameter "coefficient of wear resistance" (CWR), which is the product of frictional force, sliding distance and inverse of wear volume, can be used to characterize the wear behaviour. CWR value demarcates distinctly the wear behaviour amongst the base metal, weld metal and the varied regimes of heat affected zone (HAZ).

Keyword: *steel, sliding wear, pre-strain, hardness, critical pre-strain, weld-joint, CWR., wear rate, delamination*