

Effect of relative humidity on the unlubricated wear of metals

Abstract

Experiments were carried out to investigate the effect of humidity on the wear behaviour of same metal combination, i.e. steel-steel and aluminium-aluminium. The sliding wear of steel was found to increase by nearly 1.5 orders of magnitude when the relative humidity (RH) of the surrounding air decreased from 80 to 28% RH. At low humidity, both delamination and adhesion wear occurred. At high humidity levels, both delamination and adhesion wear took place at a relative small scale and the frictional force was considerably lower than that obtained at lower humidity levels. It is proposed that the low wear occurring at high humidity levels is due to the inhibition of these wear mechanisms by the formation of interfacial layers, possibly iron hydroxide and ferri-oxide-hydrates, and the adsorption of water on the worn surface in addition to the normal atmospheric oxidation. Increasing the humidity from 28 to 80% RH. increased the wear rate of aluminium by nearly half an order of magnitude. It is proposed that at higher humidity levels, water vapour adsorbs on both the freshly created surface and wear debris generated and therefore the wear debris egresses easily from the contact area without adhering to the parent surfaces. Lack of adhering wear debris exposed the worn surfaces to metal-metal interaction.