

Tribocorrosion

Tribocorrosion is a combination of complex mechanical and chemical processes leading to the degradation of a metallic and/or non-metallic material. Mechanical processes primarily include friction and wear whereas chemical processes generally refer to corrosion. Friction can be defined as resistance to force applied. Wear can be defined as progressive damage involving material loss. Corrosion refers to the deterioration of a metal and its properties due to chemical reactions between the material and the surrounding environment.

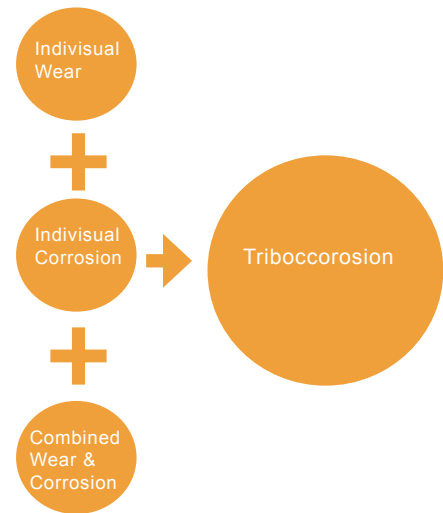
The total loss due to tribocorrosion is generally defined by an equation

$$T_{loss} = W_{loss} + C_{loss} + S_{loss}$$

where T_{loss} refers to total material loss due to tribocorrosion, W_{loss} refers to material loss due to wear in absence of corrosion, C_{loss} refers to material loss due to corrosion in absence of wear and S_{loss} refers to material loss due to synergy of wear influenced by corrosion and corrosion influenced by wear.

Industries like automotive (piston, valves, and cylinders), biomedical (joint prostheses), chemical, petrochemical (pipelines), nuclear, aerospace, marine, food, and offshore industries are affected by tribocorrosion.

Tribocorrosion in passive metals: Surfaces of passive metals such as chromium, titanium, aluminium, tantalum and niobium undergo oxidation reaction with the surrounding air or moisture to form a thin oxide film. These films, though of very small atomic size, act as protective barrier between the metal and its environment. They also provide excellent and long term corrosion resistance and even if the film is accidentally removed or damaged, it requires a very small amount of oxidation to self-heal. When



surfaces of metal undergo severe rubbing, sliding or are in continuous touch with a stream of impacting particles such as water droplets or debris, the self-healing characteristics of these passive films deplete and a larger amount of metal oxidation is required than before, for replenishing the passive film.

As the film is wiped off, the nascent metal becomes exposed to the surrounding air, moisture, water vapours and begins to corrode which cripples the entire structure of metal. Hence in the case of passive metals, the damage caused due to the combined action of corrosion and wear results in high material loss in comparison with corrosion and wear taking place separately.

Tribocorrosion testing: Testing for tribocorrosion involves specific setups comprising of an electrochemical cell and a tribometer. The setup allows friction and wear tests to be conducted under the influence of electrochemical potential.

Chemo-mechanical polishing: Tribocorrosion is sometimes beneficial as well. Chemo-mechanical polishing is an essential part of the production of integrated circuits and can be referred to as smoothing of surfaces with a combination of chemical and mechanical forces. In other words, it's a controlled tribocorrosion process. The process has been used by the semiconductor industry for polishing tungsten, aluminium, copper and other metals used to fabricate IC chips.

Tribocorrosion prevention and control: A wide variety of coatings and pre, post and advanced surface treatment techniques are available, for protection of materials against tribocorrosion.

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