Wear Background

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Wear can be described as the degradation of surfaces by mechanical means. This degradation can be caused by solid particle impact, liquid impact, relative motion between surfaces in contact, by solid particles forced against surfaces, and by solid particles trapped between surfaces in relative motion. Wear of metallic materials generally falls into one of three major categories, namely abrasion, erosion, or metal-to-metal sliding. However, many sub-categories exist. For example, four types of erosion are common, namely solid particle erosion, liquid droplet erosion, cavitation erosion, and slurry erosion. The important issues in a wearing system are the amplitude and direction of the applied stresses, and the response of the surface(s) to those stresses, in terms of deformation and fracture.

Many industrial systems are complex, involving more than just mechanical stresses. The presence of water or more corrosive liquids, in a system, can significantly change the nature of the degradation process. Stainless steels, for example, which rely on passive surface films for corrosion protection, can suffer accelerated corrosion if those passive films are damaged by mechanical stresses. At high temperatures, the interactions between mechanical stresses and protective oxide films are important. Of course, many sliding systems operate in the presence of lubricants, which completely alter the stresses to which surfaces are subjected.

From a materials standpoint, there is no universal panacea to industrial wear problems. While very hard materials (such as ceramics) resist certain types of abrasion, they are less suited to types of wear involving impact, where the ability of the material to absorb energy, without fracture, is paramount. Among the metallic materials, the tool steels, bearing steels, austenitic manganese steels, martensitic alloy steels, martensitic stainless steels, and high chromium irons are known for their resistance to certain types of wear, at low to moderate temperatures, and in the absence of corrosive chemicals. In the presence of corrosive chemicals, cobalt alloys are regarded as among the most wear-resistant of the metallic materials. They are also used to resist wear in hostile, high temperature environments.