

Surface features of chromium alloyed carbon steel specimens after salt-spray tests in NaCl solution

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ABSTRACT

The most common corrosion testing procedures use flat test coupons fabricated from a given steel material. However, workpieces that undergo machining and finishing, especially those with complex geometry, may be more subject to surface degradation on their curved surfaces. In the long run, this may adversely affect the smooth operation of the tested component. This study investigates surface features of machined and finished chromium alloyed steel specimens with rather complex geometries. Changes in several important surface features (topography, roughness, cylindricity, chemical degradation rate and corrosion products) were all measured periodically (after 24, 96 and 192 hours) on several sets of manufactured carbon steel planetary axle specimens exposed to a chemically aggressive medium (aqueous NaCl spray) at 35 °C. In the neutral salt spray (NSS) testing cabinet the cylindrical parts of the chromium alloyed carbon steel shafts showed quite severe and uneven chemical degradation, with the formation of several iron oxide-hydroxide products (rust) observed together with some chromium compounds. After careful removal of the relatively loose corrosion products, the exposed bare shaft surface's geometrical changes showed steady (close to linear) increase in the roughness values throughout the duration of the corrosion tests. This chemical attack caused significant changes in the surface topography as well. It was found that the average values of roughness parameters after the 24-hour test were about two and a half times higher than the original values, while they increased by four-fold in the 96-hour test and by approximately eightfold in the 192-hour test. Furthermore, it was found that the values of the 3D roughness parameters (Sa, Sz, Sq) are on average twice that of their 2D counterparts (Ra, Rz, Rq) on the corroded surfaces. Circularity and roundness error data showed a similar increase with salt-spray test time duration.

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