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Effects of work hardening on mechanical metalproperties—experimental analysis and simulation by experiments

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Abstract: The aim of the present work is to improve the materials' performances, particularly their elastic property based on an optimalexploitation of surface work-hardening phenomenon, using surface plastic deformation treatment (DPS). The surface of amechanical piece is considered as the most vulnerable zone that determines its mechanical performances. To improve thesurface physico-mechanical properties, the surface plastic deformation treatment (DPS) is often used. The (DPS) acts by acombined action of: surface hardening, structural modification, and the generation of the compression residual stresses, thefactors that will create a heterogeneous plastic deformation. Knowing that during operation the mechanical pieces have to besubjected to a stress smaller than the elastic limit (taking into account the safety margins), where the material behavior isreversible, and to reach the maximum allowable stresses, we have to increase the material's elastic limits. This objective canbe realized through an optimal use of work hardening phenomenon for the treated surface by the DPS. The work hardening ischaracterized by the increase of the yield strength (Re), the surface hardness (Hv), and consequently the increase of thebrittleness. Depending on the considered metals, when the piece has a defect variation: cavity, inclusion (precipitate), orzones of different hardness, it can create a stress concentration which generates a local hardening. This phenomenon is one ofthe main causes of crack generation. In our study, we consider the influence of work hardening on the elastic behavior ofXC38 steel and aluminum alloy.

Keywords : Work hardening . Hardening of materials . Mechanical surface treatment (TMS) . Burnishing