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Study on Electromagnetic Force Distribution and Copper Fatigue Performance in Electromagnetic Strengthening with Axial Compression

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The surface compressive stress can improve the work piece fatigue performance effectively and the existing strengthening technologies can increase the work piece fatigue life in varying degrees. However, they would lead to some negative results such as uneven residual stress and poor surface quality. In order to solve these problems, the electromagnetic strengthening technology with axial compression is firstly proposed in this paper. In this process, the surface compressive stress is generated by a pulsed electromagnetic force; specifically, both the radial and axial compression on a copper bar is obtained by a designed tool coil. A transient electromagnetic-structure coupling model is established by COMSOL software. On this basis, the electromagnetic force distribution of a pure copper bar is analyzed, and then the tool coil structure is optimized. Secondly, the deformation behavior of the pure copper bar is analyzed, and the corresponding residual stress distribution is obtained. Finally, the original and strengthen sample with tensile and fatigue property is tested respectively and the effectiveness of the electromagnetic strengthening method with axial compression is verified.

Submitters Country

China

Authors: QIU, Li; YU, Yijie; LI, Liang

Presenter: QIU, Li

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