

Elevated Temperature Shot Peening for M50 Steel

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Abstract : As a traditional surface hardening technique, shot peening is widely used in industry. By using shot peening, a residual compressive stress is formed in the surface which is beneficial for improving the fatigue life of metal materials. At the same time, very fine grains and high density defects are generated in the surface layer which enhances the surface hardness, either. However, most of the processes are carried out at room temperature. For high strength steel, such as M50, the thickness of the strengthen layer is limited. In order to obtain a thick strengthen surface layer, elevated temperature shot peening was carried out in this work by using $\Phi 1\text{mm}$ cast iron balls with a speed of 80m/s. Considering the tempering temperature of M50 steel is about 550 oC, the processing temperature was in the range from 300 to 500 oC. The effect of processing temperature and processing time of shot peening on distribution of residual stress and surface hardness was investigated. As we known, the working temperature of M50 steel can be as high as 315 oC. Because the defects formed by shot peening are unstable when the working temperature goes higher, it is worthy to understand what happens during the shot peening process, and what happens when the strengthen samples were kept at a certain temperature. In our work, the shot peening time was selected from 2 to 10 min. And after the strengthening process, the samples were annealed at various temperatures from 200 to 500 oC up to 60 h. The results show that the maximum residual compressive stress is near 900 MPa. Compared with room temperature shot peening, the strengthening depth of 500 oC shot peening sample is about 2 times deep. The surface hardness increased with the processing temperature, and the saturation peening time decreases. After annealing, the residual compressive stress decreases, however, for 500 oC peening sample, even annealing at 500 oC for 20 h, the residual compressive stress is still over 600 MPa. However, it is clean to see from SEM that the grain size of surface layers is still very small.

Keywords : shot peening, M50 steel, residual compressive stress, elevated temperature

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