C. Laser Peening of Navy Alloys for Improved Fatigue Life

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Laser peening technology is an emerging surface treatment technology for metals that imparts deep compressive residual stresses into surfaces, greatly improving resistance to stress corrosion cracking and fatigue failure. In its basics, laser peening imparts a compressive residual stress to metal surfaces. With a compressive residual stress at the surface, small cracks and flaws that could easily grow into large destructive cracks are prevented from growing.

The Carderock Division, Naval Surface Warfare Center (CDNSWC) in collaboration with the Metals Improvement Company and the University of California, Davis has evaluated the potential of laser peening as a surface enhancement technology for improving the material properties of structural components and welded applications. Interest in this cutting edge technology is based on the potential offered by laser peening to improve the mechanical properties and corrosion resistance of lightweight materials such as aluminum and titanium and other alloys of interest to the Navy. An initial feasibility study involved examining the effects of laser peening on the fatigue life of welded aluminum 5059-HI 16 and high nickel MP35N alloy.

The results of four-point bending fatigue testing indicate approximately a 3.5X improvement in fatigue life of peened versus unpeened 5059-HI 16 weldments. Laser peening also significantly increases the fatigue strength of MP35N alloy. At 800,000 cycles, laser peened four point bend fatigue specimens exhibit a 70 percent increase in fatigue strength in comparison to specimens in the as-machined condition when tested at a stress ratio, R=0.1 and notch sensitivity factor, Kt=l .3.

The results of these initial efforts in indicate that significant life improvements can be obtained using laser peening.