B. Friction Stir Processing Of Nickel Aluminum Bronze

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Nickel Aluminum Bronze (NAB) has been primarily used in the design of marine propellers because of its reliability and durability. With keel block requirements of 35ksi yield strength, 85 ksi, ultimate tensile strength, and 10% elongation, large propeller blades often have lower values due to casting defects. Current weld repair is costly and untimely because it involves inspection, removal of material, weld repair, and reinspection of the repair. Large repairs may also need re-machining due to dimensional and physical changes. Because of this, Friction Stir Processing (FSP) is being investigated as an alternative manufacturing tool to enhance material performance of ship repair.

FSP is a solid-state repair process that uses a high compressive load and contact of a rapidly rotating pin tool to create frictional heat. After homogeneous heating and softening of the material, a lateral force allows pin tool travel. The rotation of the pin tool allows softened material to be “stirred”, whereby the material is swept along the pin and deposited in its wake. NSWCCD is evaluating FSP as an alternative to fusion welding for surface defect removal, with specific focus on removal of porosity within the cast material. Secondly, NSWCCD is looking to FSP as a tool to locally enhance the strength properties of the cast NAB.

This presentation will summarize an ongoing evaluation of the feasibility of FSP for repairing NAB propellers. We will present the resulting surface quality and mechanical property improvements of processed regions, as well as a structural analysis that illustrates the benefits of using FSP to improve the localized properties. Finally, the presentation will address how the improvements afforded by FSP will allow the materials engineer and the structural designer to optimize the properties on the surface of large new or in-service propellers, thereby to extending the performance envelope.