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LPB® Application Note

IMPROVING COMPONENT LIFE AND PERFORMANCE

STEAM TURBINES

LPB processing of a turbine blade

LPB Mitigates Corrosion Fatigue in Steam Turbine Blades

Corrosion Pitting in Steam Turbine Blades

Steam turbines provide 80% of the world's electricity, making them the backbone of power generation. Repeated exposure to high vibratory stresses and extreme steam environments leads to stress corrosion cracking (SCC) and fatigue failure in the turbine blades. Replacing damaged blades costs millions of dollars and can take months. The use of welding and identical replacement parts result in 50% of failures reoccurring. Low Plasticity Burnishing (LPB®) applies a deep, stable layer of compression in high stress areas of turbine blades to extend life and reduce costs.

- Shortens Inspection Times
- Reduces Maintenance and Replacement Costs
- Increases Safety
- Prevents Forced Shut Downs and Outages
- Restore Strength After Weld Repair

LPB is engineered to impart the exact level of compression required for the component. Robotic systems allow for on-site processing without requiring a full tear down. Lambda provides complete process design and can develop a production solution to meet your needs.

www.lambdatechs.com

Lambda Technologies ■ 3929 Virginia Avenue, Cincinnati, OH 45227
Tel (513) 561-0883 ■ Toll Free/U.S. (800) 883-0851 ■ Fax (513) 322-7186

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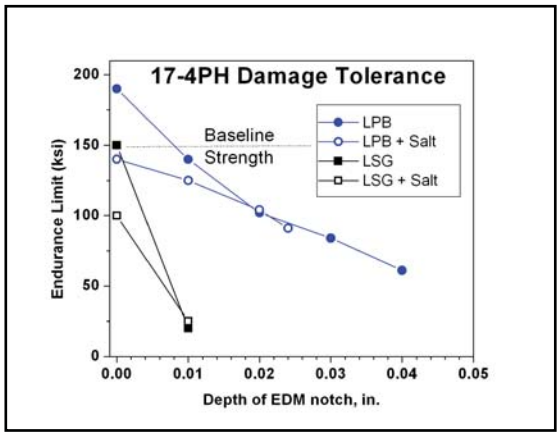
Mitigating Corrosion Fatigue in Steam Turbines

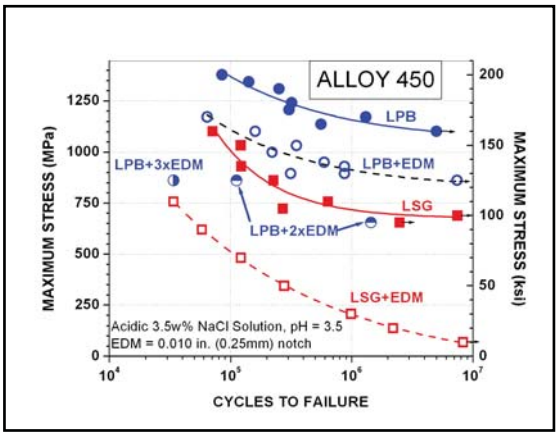
Condensation in the low pressure steam turbine environment leads to corrosion pitting and corrosion fatigue, the primary failure mechanisms driving steam turbine repair and operational expenses. LPB has been shown to dramatically improve the corrosion fatigue strength of ferritic/martensitic stainless steels as well as mitigate pre-existing damage in both titanium and steels.

Results from corrosion fatigue tests with and without surface damage were compared for LPB and Low Stress Ground specimens. Surface damage was simulated by introducing a semi-elliptical EDM notch. LPB increased the undamaged fatigue strength of 17-4PH by 30% in neutral salt solution, and Alloy 450 by 50% in acidic salt. In both alloys, LPB entirely mitigated damage to the 1mm depth of compression. The cyclic stress component of corrosion fatigue was also eliminated by LPB, restoring the endurance limit lost in active corrosion fatigue.

Processing can be performed at Lambda's facilities or a complete turnkey system can be installed in the production plant or MRO. Operating an automated LPB system does not require extensive training, and equipment can be suited to match existing CNC machines or robots. The LPB process only takes a few minutes, and with robotic integration, it can even be performed in-situ. This is particularly beneficial for unscheduled maintenance. LPB processed parts are still 100% original equipment. The life extension afforded by treating the surface makes running OEM components cheaper than buying aftermarket blades. LPB processing costs only a fraction of the cost of replacement blades, providing extended operating life and savings over time.

Replacing or repairing a damaged blade is very expensive, with downtime for the turbine often extending into months. The average operator spends between 3-6 million dollars per outage on routine steam turbine maintenance. LPB processing of critical components can reduce these costs significantly.





References:

- R. Ravindranath, N. Jayaraman, and P. Prevey, "Fatigue Life Extension of Steam Turbine Alloys Using Low Plasticity Burnishing (LPB)." Proceedings of ASME Turbo Expo 2010: Power for Land, Sea and Air. Glasgow, UK, June 14-18, 2010.

http://www.lambdatechs.com/publications/publications.html

Accreditation:

- ISO/IEC 17025 Accredited Laboratory
- ISO 9001:2008 Certified

To learn how LPB®can increase the life of your turbines, please visit www.LambdaTechs.com or contact Kim Bellamy at (513) 561-0883.

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