ABSTRACT

The root section of a turbine blade is the most critical part as it forms the structural bond of the turbine blade to the shaft. If not maintained correctly the blade could fail catastrophically due to high and low cycle fatigue, stress corrosion cracking as well as corrosion fatigue. The sources of loading on the blades vary from normal operation, excitation of natural frequencies during transient occasions and overloads during statutory testing. Different surface modification technologies can be put in place to improve blades in-service performance. The present study is aimed at comparing previous results achieved from Shot Peening (SP) of an equivalent turbine blade to those achieved by Laser Shock Peening without coating (LSPwC).The SP data which is used for comparison is from the work and study done to optimise the SP of a 12Cr steel steam turbine blade. It is expected that LSPwC processing of the blade will result in a reduction in mean surface roughness (Ra), and deeper compressive residual stresses than the conventional SP processing. The focus of this investigation is also to determine the effects of LSPwC laser and processing parameters, such as laser intensity, laser spot size, coverage, water layer, and possibly laser wavelength on the X12CrNiMo12 high strength steel target material.

Segments of an ex-service turbine blade, 20x20mm by 10mm thickness, processed at the CSIR National Laser Centre under various LSPwC parameters were analysed as follows: composition properties confirmed by spark tests; surface integrity assessed by SEM and 3D roughness mapping; microstructure; residual stress measurements by laboratory X-ray Diffraction. The experimental results helped in optimizing the LSPwC parameters for the X12CrNiMo12, before applying LSPwC to the more complex geometry of the blade root. This study then allowed for the determination of which peening process is most suited for turbine components.