ABSTRACT

It has been observed quite a long time that the wear and corrosion are the most common problems in the mineral processing equipments. The screening equipment, automotive shafts, crankshafts, connecting rods, axle, gears, are typically made of En19 steel. The reasons for the frequent failure of these components are due to impact, wear and fatigue. Frequent replacement of these components increases the equipment downtime and maintenance cost, thereby reducing the process efficiency.

Cryogenic treatment of steels plays an important role in developing the tribological properties of steels. One of the most common claims in cryogenic treatment is an increase in wear resistance of steels. Supplementing cryogenic treatment to conventional heat treatment process will aid the manufacturers to attain better wear resistance of steel components. Cryogenic treatment helps to transform the retained austenite to martensite along with the carbide precipitations. Hence, an effort has been made to investigate the influence of cryogenic treatment on En 19 steel.

The effect of Deep Cryogenic Treatment (DCT, -196°Cx 24h), Shallow Cryogenic Treatment (SCT, -80°Cx 5h) and Conventional Heat Treatment (CHT) on En19 steel is made by means of various mechanical

testing. Two kinds of cryogenic treatment, namely Shallow (SCT, -80°Cx 5h) and Deep Cryogenic Treatment (DCT, -196°Cx 24h) are carried out between quenching and tempering in conventional heat treatment process.

The present research work studies the effect of cryogenic treatment on some mechanical properties namely hardness, wear resistance, tensile and impact strength. Fracture features of tensile specimens are also compared by using Scanning Electron Microscope. In order to determine the influence of cryogenic treatment on retained austenite and residual stress, X-ray diffraction studies are carried to identify the changes brought in by the cryogenic treatment process. Moreover, corrosion and damping behaviour is also found out. Microstructural analysis is carried to find out whether the changes are observed between CHT, SCT and DCT samples before and after tempering. In this research work, the deep cryogenic and heat treatment parameters are also optimized for attaining minimum wear loss of En 19 steel.

This research work concludes that the DCT enhances the hardness, wear resistance, toughness and corrosion resistance of En 19 steel when compared to CHT and SCT. It also increases the compressive residual macro and micro stress state of the surface of En 19 steel. The retained austenite content along with the carbide precipitation is responsible for the improvement. It is also observed that there is no significant reduction in the tensile strength in DCT sample whereas the reduction in tensile strength

observed for SCT samples is 8.21% when compared to CHT samples. Moreover, damping capacity is more or less same for all the treated samples. Apart from the significant increase in wear resistance due to DCT, it also helps to provide more benefits pertaining to other properties compared to CHT and SCT samples. Hence, the deep cryogenic and heat treatment parameters are optimized to reduce wear loss of En 19 steel. Finally, the DCT is recommended to enhance the behaviour of En 19 steel.