ABSTRACT

Wire electrical discharge machining (WEDM) is used to manufacture conductive hard metal components with intricate shape, greater tolerance and precision. A review of the literature reveals that most of the research work has been directed towards the optimization of WEDM operation and modeling of the process. Conventional wire electrode has been developed to a brass wire from a copper wire and finally to zinc coated wire on the brass, steel or copper wire core, by which more advanced WEDM, is realized in terms of better machining speed and accuracy. The available literature also reveals that the cryogenic treatment has been successfully employed to many ferrous and non-ferrous materials. The present research work has been focused on the following aspects:

- Detailed study for the effect of cryogenic treatment to wire electrodes used in WEDM.

Experimental setup has been developed to conduct the different set of experiments. The untreated and cryogenically treated brass wire electrodes have been tested for various properties, like micro-hardness, tensile strength, conductivity. The microstructure and crystalline phase of deep and non cryogenic treated brass wire electrodes has been observed by SEM and XRD. It has been observed from experimental results that the wire grains are more refined in deep and shallow cryogenically treated wire electrodes. The electrical conductivity of deep and shallow cryogenically treated electrode has significantly improved. The ANOVA analysis indicates the significant factors for maximization of MRR, improvement of SR and WWR. The optimal results have been validated by confirmatory experiments. The utility based Taguchi loss function strategy has been used for the multi-response optimization of WEDM with the use of cryogenically treated wire electrodes. From the research work, it has been concluded that the deep and shallow cryogenically treated wire electrodes have enhanced the MRR, improved the surface finish and WWR significantly.