**Summary of work**

High-strength low-alloy (30CrMnSiA) is widely used in aviation and aerospace industries. Effect of WEDM parameters on various performance parameters namely MRR, SR and DD on HSLA steel have been investigated. However, surface integrity on HSLA (30CrMnSiA, 38HRC) steel using molybdenum wire has not reported yet.

The research thoroughly investigates the effect of WEDM process parameters on surface integrity HSLA steel (30CrMnSiA) and adds important knowledge regarding the WEDM process in combination with the HSLA steel.

Objectives of this research have been addressed and are summarized as below:

1. Surface integrity of HSLA (30CrMnSiA) steel in wire electrical discharge machining (WEDM) process has been investigated. Recast layer has amorphous and columnar structure. Defects such as micro-voids and micro- cracks are present in this layer. Micro-hardness of recast layer was found to be 52~56HRC, which is higher than the hardness of base metal (38HRC). The surface layers in HSLA steel are divided into recast layer, heat-affected zone and base material. The top layer consists of re-deposited material; middle layer consists of elongated grains and base material is unaffected during the WEDM process. Machined surface is oxidized and is free of alloying effects from moly wire. Surface morphology of machined surface is influenced by surface irregularities such as craters, globules and micro-voids. Pulse-on time is the most dominant process parameters to control these irregularities and thus the surface morphology.

2. Significant parameters affecting the surface integrity and cutting speed (CS) have been determined. The significant process parameters for recast layer thickness were pulse-on time and wire speed. However, the effect of both parameters is different. Thickness of recast layer decreases by decreasing the pulse-on time and increasing the wire speed and vice versa. The significant process parameters affecting cutting speed are pulse ratio, power and pulse. Higher cutting speeds are achieved at larger value of power while using smaller pulse ratio and pulse values.

3. Cutting speed has been modeled and optimized. Model developed has been validated through residual analysis and confirmation experiments. Surface integrity of HSLA (30CrMnSiA) steel in WEDM process was evaluated on the basis of MDS using using Scanning electron microscope. However, recast layer thickness (RLT) has been characterized through design of experiments (DOE) and statistical analysis.

4. Mathematical model relating the cutting speed and WEDM process parameters have been established. The fitted regression model in terms of actual variables is expressed as equation and is used for predictions about the cutting speed.

5. Optimal WEDM process parameters under the constraints and requirements have been obtained yielding higher productivity.

This research contributes significant new transferable knowledge to existing body of WEDM in the form of process innovations and insights into the influence of WEDM process in combination with HSLA steel. The material investigated and the results achieved, owing to their novel nature will have significant impact in the field of WEDM.