ABSTRACT

Electrochemical grinding (ECG) has become more and more important for its industrial use, in machining problems associated with grinding hard and wear resisting and even very soft electrically conductive materials. In a survey on ECG process, little attempts on theoretical analysis of the process rather more experimental investigations have been made.

The main objective of the present work was to develop theoretical models to explain joint phenomena, mechanism and electrochemistry i.e. (i) to determine metal removal rate due to mechanical and that of electrochemical action individually, (ii) to find out the feed force required in ECG process, and (iii) to corroborate the models with experimental results. For this, an industrial model for the electrochemical grinding machine with hydraulic feed control system has been developed retrofitting an existing obsolete manual feed surface grinder. Different stages of grinding action are thoroughly analyzed and corresponding force components are established in terms of chip thickness, stress and loading coefficients. An octagonal extended ring type grinding dynamometer of stainless steel has been designed, constructed and calibrated. A high gain operational amplifier has been built to record force components.

Electrochemical grinding geometry and kinematics are analyzed, and electrochemical and mechanical aspects of the process have been extensively studied. Investigation on the different process parameters and their inter-relations are also made.

Experiments have been conducted on stainless steel and tungsten carbide (GT 20) to examine the validity of the theoretical works and other experimental investigations. Theoretical analyses have been carried out on the determination of MRR and feed force. Different stages of grinding actions viz. sliding, ploughing, cutting, rubbing, viscous drag due to electrolyte pool are considered in feed force analysis. The depth of cut is used for combined mechanical and electrochemical

actions. They are experimentally verified and found within the closure range of acceptance for industrial exploitation. The results indicate that material removal rate due to electrochemical action can be achieved up to 90% of the total material removed, and as a result, the feed force in ECG is found very less compared to conventional grinding.

Key words: electrochemical grinding, material removal rate, feed force, dynamometer, calibration, electrochemistry, electrolytic action.