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Abstract

This paper describes development of theoretical models of volumetric material removal rate (*MRR*) and surface roughness depth (R_z) of straight bevel gears finished by pulse electrochemical honing (PECH) process in terms of the most influencing parameters namely applied voltage, pulse-on time, pulse-off time, finishing time, inter-electrode gap, electrolyte conductivity and workpiece gear rotary speed. Equations for computing flank surface area of gear tooth flank surfaces in terms geometric parameters of involute profile of straight bevel gears were also developed. The developed models were validated by conducting twelve experiments using one-factor-at-a-time approach and varying applied voltage, pulse-on time and pulse-off time each at four levels. Values and trends of variation of volumetric MRR and surface roughness depth predicted by the proposed models have shown very close agreement with corresponding experimental values and their trends. Minimum prediction errors for the proposed models were found to be -3.3% and 1% for volumetric MRR and surface roughness depth respectively. Models and validation results have also revealed the existence of optimum ranges of voltage, pulse-on time and pulse-off time to optimize volumetric MRR and depth of surface roughness. Analysis of different aspects of surface quality (i.e. surface finish, material ratio curve, micro-geometry, tooth flank topology) and surface integrity (i.e. microstructure and micro-hardness) of the best-finished gear have shown considerable improvements in them.

Keywords:

Theoretical models; MRR; Roughness depth; Bevel gear; PECH.