International Journal of Applied Engineering Research ISSN 0973-4562 Volume 12, Number 19 (2017) pp. 8660-8664

Optimization of Internal Grinding Process Parameters on C40E Steel Using Taguchi Technique

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Abstract

In a manufacturing sector we all know how essential it is to maintain the quality and to what extent the role of dimensional accuracy and surface finish plays an enhancing the quality. To attain good surface finish for any work piece material, various machining parameters are considered during machining. The various machining processes available to achieve a superior surface quality are grinding, honing, lapping and burnishing. Current work relates to the internal grinding process and its characteristics which help in improving the surface finish of the work piece material and dimensional accuracy. The C40E steel has been chosen for this experimental work as it has excellent applications in industrial sector namely automobile shafts, axles, spindles, studs, etc. In this investigation the internal grinding of C40E steel was executed for the optimization of output parameters with respect to change of input parameters. The cutting force, cutting speed and depth of cut were chosen as input parameters for this experimental work and output was optimized using Taguchi technique. Analysis of variance showed that, the surface roughness was bare minimum at 47.2N cutting force, 0.0084m/min cutting speed and 0.10mm depth of cut.

Keywords: Internal Grinding; C40E Steel; Cutting Force; Cutting Speed; Depth of Cut; ANNOVA

INTRODUCTION

In general, to improve the dimensional accuracy and surface quality of the work piece internal grinding machining process could be considered. The various process parameters such as grinding wheel grain size, material removal rate, grinding wheel speed, work piece speed, depth of cut, material hardness, affects the cylindrical grinding operation. The main impact on surface roughness is feed and speed. The feed and speed are the main critical factors and high material removal rate leads to reduction in surface roughness [1-3]. For EN18 steel improving surface hardness and surface roughness should rise in grinding speed, cross feed and in feed. Authors identified that most important and significant parameters are work piece speed and depth of cut. The depth of cut were found as a most important factor whereas the grain size, grinding speed, number of passes and cutting fluid concentration were considered as insignificant in heat treated AISI 4140 steel during grinding operation [4-6]. For finished mild steel work piece there is a positive effect on micro hardness. The various parameters such as nozzle angle, table speed, grinding wheel speed coolant inlet pressure were considered [7-9]. For EN8 steel work piece material to produce better surface finish water soluble were used as a cutting fluid and it was found to be better than pure oil used as water when mixed with oil has a better flow rate and viscosity is also very low resulting in a smooth action during grinding [10-12]. The depth of cut, feed rate, and grit size parameters were considered and the same factors were also influencing the effect of surface integrity in silicon carbide during grinding and insisted for increase in feed rate for decreases in surface damage and percentage area. The grit densities affected by the variation within the range were also considered [13-15]. To reduce the specific energy, grinding force, acoustical emission and roughness values the pure oil was used. The high lubricating power of pure oil is results in reducing the generation of heat in the grinding zone and also decreases the friction. To obtain high-quality superficial dressing, pure oil was used as a grinding fluid and lesser tool wear was observed to be best suited for industrial applications [16-18].

The efficient supply of metal working fluids (MWF) in grinding plays a key role in controlling the thermal conditions in the grinding arc. However, the suitable MWF supply in grinding is dependent on various parameters which are MWF flow rate, the jet velocity, the jet shape, the nozzle position [19-21]. The present work follows Taguchi optimization