An experimental investigation of effect of turning AISI 1040 steel at low cutting speed on tool wear and surface roughness steel

Ali Erçetin*, Üsame Ali Usca

Abstract

In this study, the effect of different cutting speeds on cutting tool wear and surface roughness was investigated in turning operation. Cylindrical bars of AISI 1040 steel was selected as workpiece materials during this investigations in turning process. The K type coated CVD(Chemical Vapor Deposition) TiAIN ceramic tungsten carbide cutting tools were used in turning of bars. Surface roughness of turned bars and tool wear were accepted as criteria for performance evaluation of these cutters. Tool wear was determined by performing SEM (scanning electron microscopy) and EDX (Energy Dispersive X-ray spectroscopy) analyses after conducting other experimental studies at a constant feed rate. Surface roughness values were also measured after every turning process. The aim of this study was to investigate the influence of cutting speed, especially low cutting speed on tool wear and surface roughness. According to experimental results, decreasing of cutting speed forces the cutting tool more and increasing of cutting speed not only causes more coating wear, but also increase radius of cutting nose. However, the best surface roughness could be obtained in turning process for max cutting speed.

Keywords: Turning; tool wear; surface roughness; SEM; AISI 1040

AISI 1040 çeliğinin düşük kesme hızında tornalamanının takım aşınması ve yüzey pürzlülüüğine etkisinin deneysel incelenmesi

Özet


Anahtar KELIMELER: Tornalama; takım aşınması; yüzey pürzlülüği; SEM; AISI 1040

1. Introduction

Nowadays, machinability of steels has an important place in engineering industries. Engineering industries have competed with each other by working to obtain min production price and max production speed at machinability of steels. Operating of cutting tools at larger depth of cut and higher machining speeds causes higher working temperature and tool failure rate. Application of machinability methods has importance to learn machinability characterization of every material [1-4]. Gear wheels, shaft bearings, cylindrical system pieces which are working in contact with each other can be manufactured through machinability method. Decreasing of wear situation and good surface quality in these pieces are wanted [5, 6]. Many factors affect surface roughness such as continuous or intermittent machining, tool geometry, cutting speed, depth of cut, feed rate, type of workpiece, rigidity of holder and machine tool [1].

Surface deformation, fast worn and broken of cutting tools can be encountered after using coated or uncoated cutting tool and choosing wrong turning parameters when trying to obtain certain surface roughness values [7-11]. Titanium based coatings like TiN, TiC, TiCN and TiAIN and aluminum based ceramic coatings like Al₂O₃ are especially preferred because of good performance during cutting process [4, 12]. Among the types of coatings for cutting tools, TiN/Al₂O₃ coating is one of the most wear resistant coatings [2, 13] and also increase the cutting toughness of