

ANALYSIS OF MACHINING CHARACTERISTICS IN HARD TURNING

Debajyoti Ray

Department of Mechanical Engineering, Sanaka Educational Trust's Group of Institutions,
Durgapur 713212, India

*Corresponding Author Email ID: debajyotiray2013@gmail.com

ABSTRACT

Precision hard turning, an alternative to the conventional turning-hardening-grinding process sequence is a cost-effective and high productivity process for components which are often hardened above 45 HRC. In the present work, an attempt has been made to analyse the influence of the cutting parameters such as, cutting speed and feed on the cutting force and average surface roughness obtained during hard turning of bearing steel hardened nearly to 60 HRC using uncoated polycrystalline cubic boron nitride inserts. Experimental results indicated that cutting force and average surface roughness decreased with the increase in the cutting speed and increased with the increase in the feed rate. Therefore, higher cutting speed and a lower feed rate is recommended for better machining performances indicated by lower cutting forces and lower surface roughness.

Keywords: *Hard Turning, Cutting force, Surface roughness*

1. INTRODUCTION

Many components used in aerospace, automobile and engineering applications are made up of tool steels, bearing steels, high speed steels, super alloys etc. Usually components made up of these materials are machined near net shape in annealed condition, heat treated to the desired hardness and finally brought to final dimensions and tolerances by grinding [1]. This process involves lengthy setups, long production cycle, costly support equipments and high capital investment in grinding machines. With the development of computerised numerical control (CNC) machine tools and advanced cutting tools such as polycrystalline cubic boron nitride (PCBN), these many setup process was slowly substituted by a single setup hard part machining (HPM) process, where the heat treated hardened work piece is finish machined in a precision machining centre. Hard turning is one of the hard part precision machining method done on CNC precision turning center with PCBN inserts carried out at high cutting speed and low feed rate and depth of cut. Small depth of cut and low feed rates are chosen to reduce the mechanical and thermal loads on the tool to acceptable limits. Hard turning is carried out at high cutting speed of 300 m/min or even more. So the machine tool should possess high rigidity with adequate dynamic stiffness, capability to operate safely, maintain high surface speed and achieve profile finishing with tight tolerances and surface finish [2].

Many researchers have carried out intensive work in the areas of hard turning. Matsumoto et al. [3] analysed surface integrity generated by precision hard turning. Their work showed that hard turning provided good fatigue performance and produced compressive residual stresses in subsurface, which contribute to a long fatigue life. Grzesik et al. [4] investigated surface integrity generated in hybrid machining comprising of hard turning and finish abrasive machining. Waikar and Guo [5] made extensive analysis to evaluate comparative findings on 3D surface topography induced by hard turning versus grinding. Melkote et al. [6] carried out experiments to determine the effects of tool cutting edge geometry and work piece hardness on the surface roughness and cutting forces in the finish hard turning of AISI 52100 steel. Their study showed that large honed edges resulted in higher average surface roughness values than small honed edges due to increase in the extent of ploughing compared to shearing.

Cutting force and surface roughness are important machining process performance characteristics that indicates the machinability of a material and assess the effectiveness of a process to machine a material. Cutting force and surface roughness are influenced by cutting parameters namely cutting