Parametric Study of Surface Roughness of Cylindrical Bars of Mild Steel, Aluminium and Copper on Lathe Machine

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ABSTRACT

The current investigation deals with the study of factors affecting the surface Roughness of cylindrical bars of copper, aluminium and steel. The specific effect of variation of speed of spindle and feed rate has been studied at constant depth of cut. It could be concluded that while the surface Roughness increased with increase in speed of spindle, the same decreased with increase in feed rate. The surface Roughness is found to increase with the increase in hardness value of the material.

KEYWORDS: speed of spindle, material removal rate, lathe.

I. INTRODUCTION

Mild steel, Aluminium and copper find various applications in different industries due to the inherent properties like ductility, strength, stiffness, elastic and endurance limit. Whereas, mild steel finds ample applications in bullets, nuts and bolts, Chains, Hinges, Knives, Armour, Pipes and similar applications, the aluminium and copper or the alloys of the same find a wide range of applications such as, in areas involving high strength characteristics at elevated temperatures.

II. LITERATURE REVIEW:

Abdullah [1] obtained the sensitivity of the surface roughness investigating the cutting speed, depth of cut and depth of cut programmed in Turbo C++. Noorani [2] studied the effects of CNC machining processes on Aluminum alloy 6061 samples for its surface roughness.it was concluded that The combination for achieving this type of surface Roughness is best when the spindle speed is running at its highest. Chakraborty [3] studied the material removal rate using the back propagation neural network and found the same to be in good agreement to the experimental values. The effects of cutting speed, feed rate, depth of cut and nose radius on the surface Roughness of steel was studied by Albrecht [4]. Critical investigation of the cutting tool material on the surface Roughness of machined product was investigated by Chandiramani [5]. Mital [6] reviewed the predications on surface Roughness done by various research workers.

III. FACTORS AFFECTING SURFACE ROUGNESS:

It could the summarised that the following are the most important factors which affect the surface Roughness:

A. *Cutting Speed:* Cutting speed is directly to surface Roughness i.e. the surface Roughness increases with the cutting speed. More the cutting speed good is the surface Roughness and we get bad surface Roughness at less speed provided that the depth of cut and feed are to be constant. The surface Roughness increases with the cutting speed due to the continuous reduction of the built up edge. After the built up edge becomes insufficient, the surface Roughness is not improved with further increase in cutting speed.

B. *Feed rate and Depth of Cut:* Surface Roughness is affected to a large extent by the dimensions of cut, i.e. depth of cut and mainly feed rate**.** With increase in feed rate and depth of cut the cutting force increases and deflection takes place which results in deterioration of the surface Roughness.

C. *Nose Radius:* This is one of the important tool geometry which plays important role in getting good surface Roughness. Surface Roughness increases with increase in nose radius. Too large value of nose radius leads to chatter. A value of 1.5mm and above is recommended for heavy depth of cuts. Turning tools using disposable carbide inserts of utility grades incorporates a standard nose radius of 0.4mm, 0.8mm and 1.2mm, while heavy duty inserts are provided with a larger nose radius of 1.2 or1.6mm.

D. *Hardness of the material to be worked on:* The hardness of any metal is the result of the chemical composition and the heat treatment of the alloy. Increasing the hardness of the metal decreases its machining characteristics. The surface Roughness increases with decrease in hardness because with increase in hardness the cutting force increases as a result of which the cutting speed decreases and surface Roughness in not good.

E. *Rigidity of the machine and work holding devices:* The efficiency of any machining operation depends on the overall rigidity of the system consisting of the machine tool, the cutting tool and the work-piece. The machine on which the material is to be machined should be rigid and should have sufficient power to withstand the induced cutting forces and to minimize deflection. If the machine is not sufficiently rigid and has less power the tool life will be reduced in addition to affecting the accuracy and surface Roughness. Lower values of the cutting speed, feed, and depth of cut have to be taken which in-turn affect surface Roughness.

IV. RESULTS AND DISCUSSION

The comparison of surface roughness vs speed of spindle is presented in Fig (1) and Fig (2). In all the cases, the depth of cut and the radius of nose are kept constant as 0.2mm and 0.4mm respectively. The feed rate is also kept constant 0.25mm/rev. From the fig. it is evident that with the increase in speed of spindle, there is linear decrease in surface roughness.

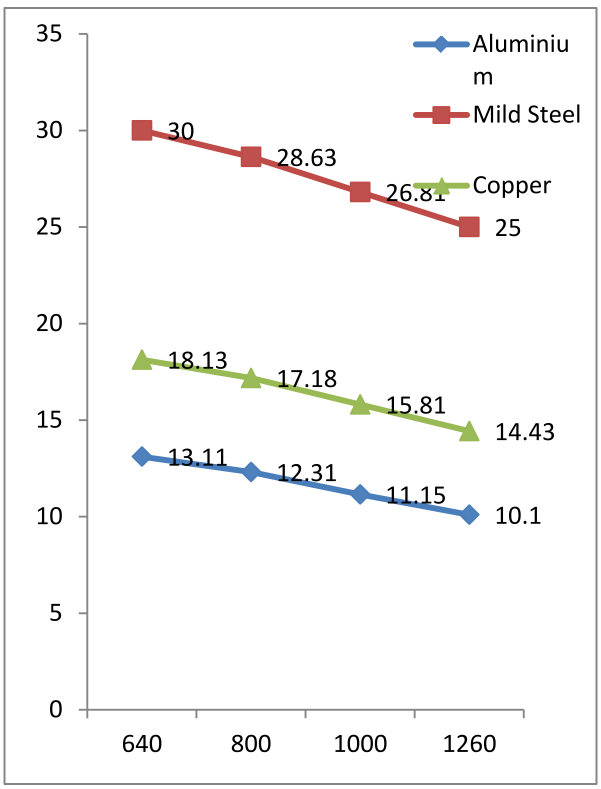

FIG: 1 Comparison of surface roughness vs speed of spindle for constant depth of cut (=0.2mm), radius of nose (=0.4mm) and feed rate (=0.25mm/rev).

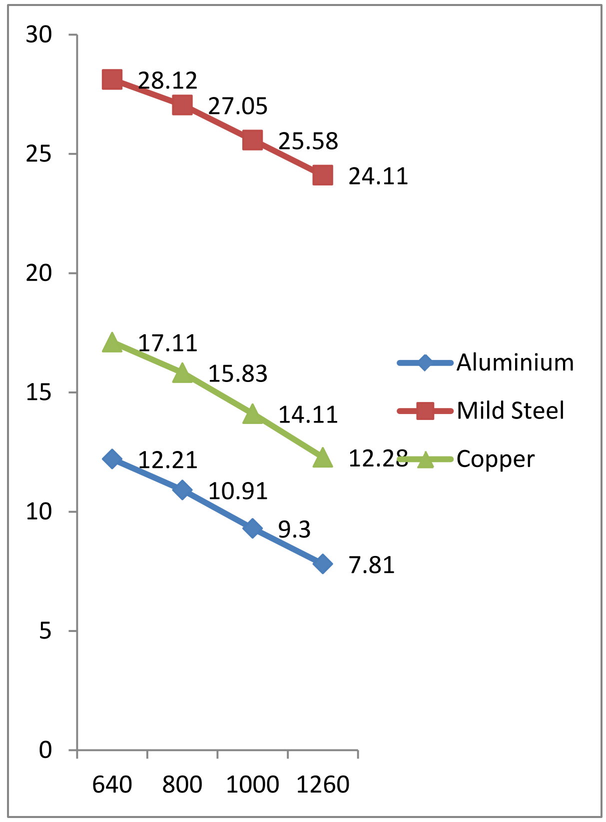

FIG: 2 Comparison of surface roughness vs speed of spindle for constant depth of cut (=0.2mm), radius of nose (=0.8mm) and feed rate (=0.25mm/rev).

The effect of feed rate on surface roughness is as shown in fig 3 and 4.. It is seen that as the feed rate increases, the surface roughness increases for constant depth of cut (=0.2mm), radius of nose (=0.8mm) and speed of spindle (= 1000rpm).

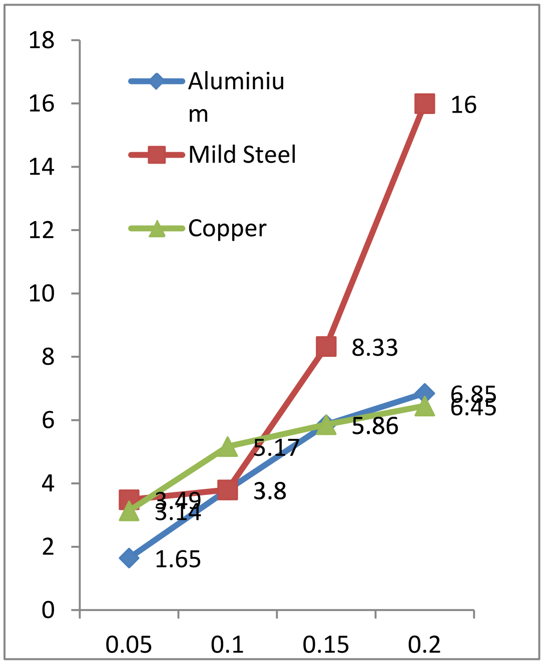

FIG: 3 Comparison of surface roughness vs feed rate for constant depth of cut (=0.2mm), radius of nose (=0.4mm) and speed of spindle (= 1000rpm).

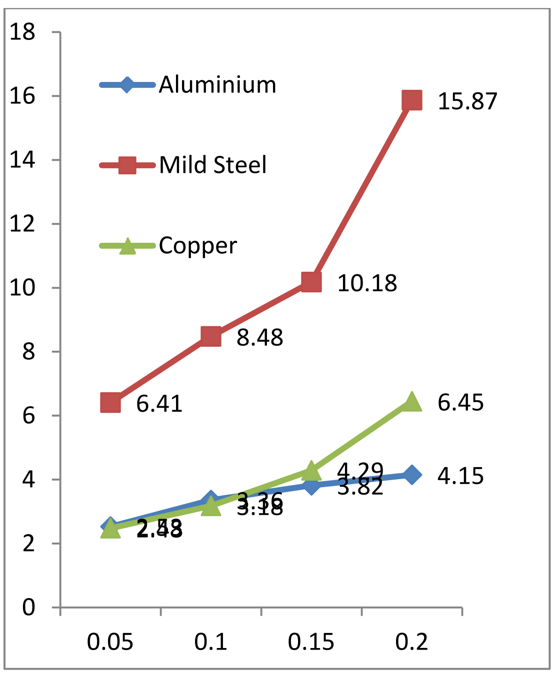

FIG: 4 Comparison of surface roughness vs feed rate for constant depth of cut (=0.2mm), radius of nose (=0.8mm) and speed of spindle (= 1000rpm).

V. CONCLUSIONS:

- Surface Roughness value decreases with increase in speed so surface finish is best at higher speed.
- From the graphs 1 and 2, the trend of Surface Roughness (Ra) value is mild steel >copper>aluminium. This could be related to the hardness value also. The harder the material, more is the surface roughness.
- Surface Roughness (Ra) value increases with increase in feed rate at constant speed of spindle and depth of cut so surface finish is best at lowest feed rate.
- The Surface Roughness (Ra) value of mild steel is same for tool with radius 0.4mm and 0.8mmfor various combination of feed at speed 1000rpm.
- The Surface Roughness (Ra) value of copper is not same for any combination of speed and feed.
- The Surface Roughness (Ra) value of the aluminium is same at one point only.

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