Performance comparison of various Dry,Paraffin and conventional coolants in turning 6082 Aluminium alloy

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Abstract

This paper dealt with experimental comparison in machining of 6082 aluminium alloy under dry, paraffin and conventional coolant conditions. The cutting temperatures values measured and considered for evaluation. It is noted that conventional coolant perform better compare to other machining conditions. The surface roughness value also get reduced in wet machining conditions compare to other machining environments..

Keywords: 6082 *aluminium alloy; cutting temperature; surface roughness; paraffin;*

1.Introduction

Aluminium is the second most structural metal available noted for its density. Aluminium and its alloy are predominantly used in the transportation industry, food industry, chemical industry and electrical industry etc..

Machining of Aluminium alloys generate Built Up Edge formation (BUE), which is affecting the surface finish (Jeelani and Musial,1986; Dae andDong,1998).When the cutting velocity is increased, the tendency of BUE vanishes, due to high cutting temperature and reduction in cutting force (Oishi and Mirror,1996))

The conventional liquid lubricants are utilized in machining operations to develop surface finish values of the work-piece and life of the cutting tool . They also useful in reduction of temperature and metal particles during machining operation. Though the use of conventional cutting fluids is effective, it has several harmful effects. The cutting lubricants used in metal cutting industries contain chemical constituents harmful to environment . These coolants are arduous to dispose of and can cause deleterious diseases to the machinist. When Minimum Quantity Lubrication conditions were used in machining 6061 alloy, the material adhesion over surface of the tool experienced nose and flank wear (Sree-jith,2008). The dry machining in turning Aluminium alloys result-ing higher temperature in the cutting zone and Built Up Edge formation. This also leads to high dimensional inaccuracies and excessive tool wear [Sreejith,2000].

2.Experimental procedure

Al-6082 alloy was widely used in Automobile and various Industries due its good strength So this alloy was considered as workpiece material. The work piece material of 75 mm diameter and 300 mm length was considered for the experimental work.

The purpose of this experiment is to investigate influence of various machining parameters under dry, paraffin and wet machining conditions. The different combination of experiments with the process variables were carried out by the turning operation on a

High speed automatic lathe (NAGMATI175).The following machining conditions were considered for turning work:

Work piece Material	**6082 Aluminium Alloy**
Cutting tool insert	Un coated tungsten carbide tool (CCMW120404)
Tool rake Angle	0
Cutting velocity (m/min)	41,95,146
Feed Rate (mm/rev)	0.079,0.159 and 0.205
Depth of cut (mm)	0.75mm
Machining Environment	Dry.Paraffin and wet

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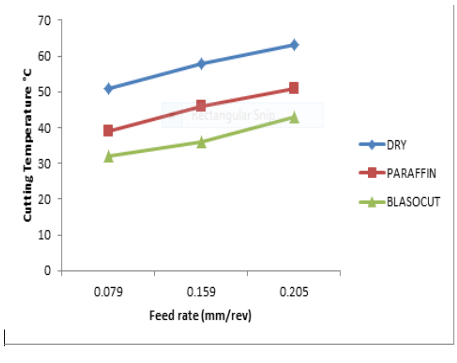
3.Results and Discussion

3.1.Cutting temperature

In turning operations, excess heat is generated at high speed in the cutting zone due to deformation of work piece material and friction at the chip-tool interface. This high temperature rise causes dimensional instability in the work piece and subsequent failure of cutting tools. The conventional cutting fluids used in turning operations reduce the temperature based on heat convection. Conventional coolants, in vapour form, reduce the contact friction of the tool-chip interface using their efficient lubricating action and penetration.

6082 Al alloy work material was turned using SCLCR M12 2020 uncoated tungsten carbide tool inserts,with different speed-feed combinations, under wet and conventional machining conditions. The results of cutting temperature values under cryogenic machining are compared with temperature values under wet machining as given below. The effect of cutting temperature with feed rate and cutting velocity in machining 6082 Al alloy under condition is shown in Figures 1 and 2



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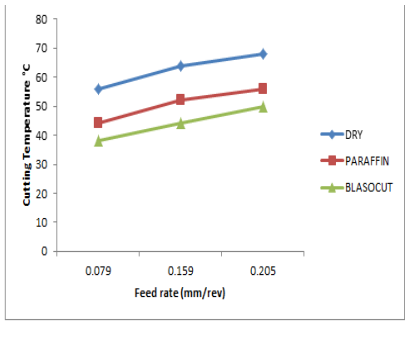

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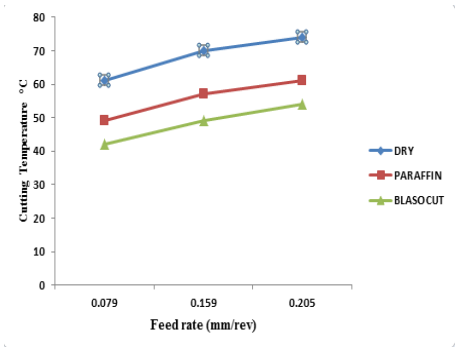

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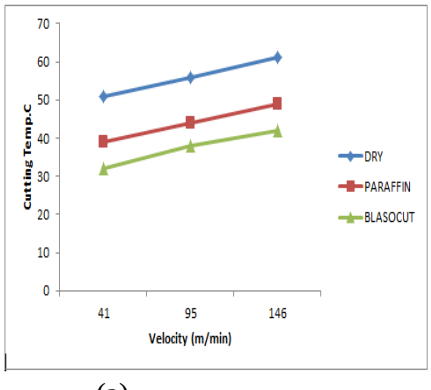
Figure. 1 Variation of the cutting temperature while machining 6082 Al alloy with different feed rates under dry, paraffin and ,conventional coolant machining conditions a)41m/min b)95 m/min c) 146 m/min



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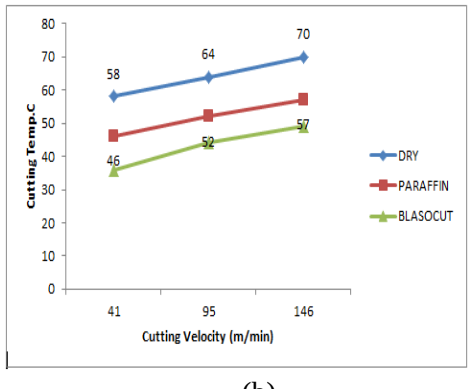

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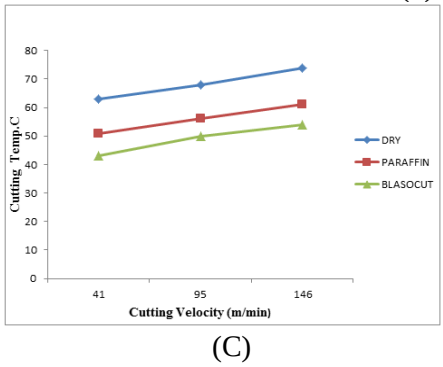

(C)

Figure. 2 Variation of the cutting temperature while machining 6082 Al alloy with different cutting velocities under dry, paraffin and ,conventional coolant machining conditions a).079 rev/min b) .159 rev/min c) .205 m/min

It can be noted that increase of cutting velocity and feed rate , proportionally increases cutting tool temperature. This was because of increase in metal removal rate and increase in friction between the work piece and tool. The temperature obtained in the wet machining condition at low speeds is more favourable for machining.The wet machining is more favourable than dry,parrafin machining conditions.The surface roughness value also observed as less in wet(blassocut) machining condition compared to other machining environments.

Conclusions

The following observations can be arrived based on machining of Al 6082 alloy under different machining environments are :

1. The cutting temperature is observed as low in wet machining condition compare to Dry and paraffin machining conditions
2. The BUE and surface roughness reduced when using coolant compared to conventional machining

References

[1] Çakir O, Kiyak M, Altan E., Comparison of gases applications to wet and dry cuttings in turning. J Mater Process Technology. (2004) 153–154:35–41.

[2] Dae, E.K., Dong, H.H., , Experimental investigation of the contact sliding behavior of metals. Journal of Manufacturing Science and Engineering, vol. 120, (1998),pp. 395-400.

[3] Dhananchezian.M, Pradeep Kumar,M, Cryogenic turning of the Ti–6Al–4V alloy with modified cutting tool inserts. Cryogenics .(2011),51:34–40.

[4] Dhar NR, Paul S, Chattopadhyay AB, Machining of AISI 4140 steel under cryogenic cooling – tool wear, surface roughness and dimensional deviation. J Mater Process Technology (2002) 123:483–9.

[5] Dilip Jerold,B and Pradeep Kumar,M., Experimental comparison of carbon-dioxide and liquid nitrogen cryogenic coolants in turning of AlSI 1045 steel in Cryogenics 52, (2012),pp. 569–574.

[6] Hong SY, Markus I, Jeong W. New cooling approach and tool life improvement in Cryogenic machining of titanium alloy Ti–6Al–4V. Int J Mach Tools Manuf .41 (2001),pp.2245– 2260.

[7] Jeelani, S., Musial,M.,Dependence of Fatigue Life on the Surface Integrity in the Machining of 224-T 351 Aluminium Alloy Unlubricated Conditions. Journal of Materials Science, vol.21, (1986),pp. 155-160.

[8] Liu J, Han R, Sun Y., Research on experiments and action mechanism with water vapor as coolant and lubricant in Green cutting. Int J Mach Tools Manuf. 45 , (2005),pp. 687–694.

[9] Oishi, K.,Mirror Cutting of Aluminium with Sapphire Tool. J Mater Proc Tech, vol. 62, no. 4, (1996),pp. 331-334.

[10] Paul S, Dhar NR, Chattopadhyay AB.,Beneficial effects of cryogenic cooling over dry and wet machining on tool wear and surface finish in turning AISI 1060 steel. J Mater ProcessTech.116(2001),pp. 44–48.

[11] Muthuraman, V & Pradeep Kumar, M, 'Performance Evaluation of Liquid Nitrogen as coolant in Turning of Al/SiC Metal Matrix Composites', Advanced MaterialsResearch,vol.893, (2014) pp. 341-345.

[12] Sreejith,P.S, Machining of 6061aluminium alloy with MQL, dry and flooded lubricant conditions. Materials Letters 62 (2008) 276 –278.

[13] Sreejith,P.S.,Ngoi,B.K.A.,Dry machining — machining of the future, J. Mater. Process. Technol,101 (1-3) (2000),pp. 289–293.

[14] Muthuraman, V & Arunkumar,S,"Experimental evaluation of machining parameters in machining of 7075 aluminium alloy with cryogenic liquid nitrogen coolant",IOP Conf. Series: Materials Science and Engineering,vol.183, (2017), pp-1-5