Optimization of Turning Characteristics of Al/SiCp Metal Matrix Composites

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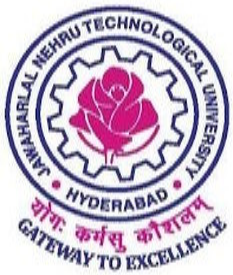

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ABSTRACT

Metal matrix composites (MMC) are widely used composite materials in aerospace, automotive, electronics and medical industries. They have outstanding properties like high strength, low weight, high modules, low ductility, high wear resistance, high thermal conductivity and low thermal expansion. Aluminium-based SiC particle reinforced MMC materials have become useful engineering materials due to their properties such as low weight, heat-resistant, wear-resistant and low cost. Machining of MMCs is the biggest challenge in manufacturing sector due to the presence of high abrasiveness of reinforcing constituents. Most of the research on machining MMCs is concentrated mainly on the study of cutting tool wear and wear mechanism. The hard abrasive reinforcement causes rapid tool wear, adversely affects the surface quality, raises force and power consumption, and decreases the tool life. Because of this, its application is significantly affected by their poor machinability and high machining costs. The most dominant wear mechanism is found to be abrasion by the hard inclusions present in the work material. The best overall machining performance has been obtained using cubic boron nitride inserts to machine an Al/SiC MMC. Machinability properties of the selected material were studied and higher SiC-p reinforcement produced a higher tool wear; surface roughness was generally affected by feed rate and cutting speed.

In present study, the surface roughness in turning of the Al/CSAp MMCs with the aid of a Taguchi design of experiment, using ceramic cutting tools under various cutting conditions.

Table 1: Process Parameters and Their Levels

Parameters	Unit	Levels (- 1)	Levels (0)	Levels (+1)
Cutting Speed (v)	m/min	60	120	180
Feed (f)	mm/rev	0. 5	1 0.	1.5
Depth of cut (d)	mm	0.2	0.3	0.4

Table 2: Experimental results and corresponding S/N ratios

SPEED	FEED	DEPTH OF CUT	R_a Al	R_a Al-CSAP	S/N Al	S/N Al-CSAp
60	0.5	0.2	2.12	1.19	-6.527	-1.511
60	1	0.3	2.57	1.66	-8.199	-4.402
60	1.5	0.4	3.2	2.25	-10.1	-7.044
120	0.5	0.3	1.93	1.06	-5.711	-0.506
120	1	0.4	2.34	1.39	-7.384	-2.86
120	1.5	0.2	2.42	1.62	-7.676	-4.19
180	0.5	0.4	1.92	0.935	-5.666	0.5838
180	1	0.2	1.87	0.99	-5.437	0.0873
180	1.5	0.3	2.39	1.36	-7.568	-2.671

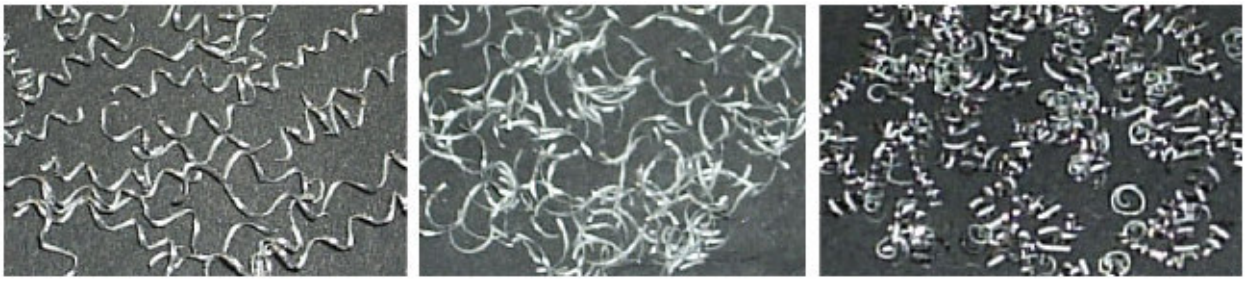

Figure 1: Chips formed during machining of Al/SiCp metal matrix composites.

The feed rate has the highest influence on surface roughness in the machining of an Al-CSAp composite followed by cutting speed and depth of cut. • Cutting conditions, such as cutting speed (60 m/min), feed rate (1.5 mm/rev), and depth of cut (0.4 mm), can be used to achieve the minimum surface roughness in machining Al, Al-CSAp composites.

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