Experimental Investigation on Turning of Aluminium Metal Matrix Composite

M.Sucharitha, B.Ravisankar, D. Ananda Rao, Y. Revanth Kumar Reddy, Y. Kumar Raja, K. Praveen Kumar

Abstract: ***Metal matrix composites are used commonly in aerospace, area ships, automotive, nuclear, biotechnology, digital and wearing goods industries. Aerospace and automotive industries are eager on introducing hybrid metal matrix composites of their components because of their first-rate mechanical and bodily houses, main to discount in the weight of structural components and power requirement for propelling. because of their excessive price, experiments are typically carried out to reduce the fee of the composites and in highly-priced substances are utilized for metallic matrix composites. Aluminium alloys are alloys wherein aluminium is foremost metal. all through stir casting, AA6061 has been all for 8% of Al2O3 by using weight as pattern. Then the pattern is made inside the form of cylindrical rod. This have a look at describes multi-element-based experiments which might be applied to optimization on machinability of stir forged AA6061 with Aluminium Oxide bolstered metallic matrix composites (MMC'S). The outcomes of parameters which includes cutting velocity, cutting Forces, Feed price, and intensity of cut, are analysed by way of experimental investigation on turning of Aluminium steel Matrix Composites.***

Keywords: Aluminium metal matrix composites (AMMC), AA6061, Al_2O_3, cutting forces.

I. INTRODUCTION

The applications of gilded matrix composites (MMCs) are being increasing day to day in each the part and vehicle industries, because of their progressed homes compared to monolithic metals. nowadays, among numerous gilded matrix composites (MMCs) synthesized, metal steel matrix composites in wellknown and discontinuously reinforced aluminium steel matrix composites, that embrace Al-SiCp/Al2O3 particularly, are emerged because the forerunner for a range of common and distinctive programs. This trend has been attributed to their superior precise strength and specific stiffness, excessive temperature capability, decrease constant of thermal growth, higher wear resistance, progressed dimensional stability, and tractability to straightforward steel forming techniques [1-4]. further, development of stir casting path for synthesis has delivered down their value to associate degree acceptable degree compared to those processed by means that of metallurgy and spray casting. but, the presence of discontinuous second section trash offers advanced mechanical and bodily homes however nonetheless, it appreciably have an effect on their "machinability" as a result of the presence of inauspicious reinforcement junk makes them take a glance at on Machinability of metallic element carbide steel Matrix Composites extraordinarily powerful to system as they result in fast device placed on. while tries are created to try and do away with machining operation, like near web form forming and adjusted casting, they will be strained associated consequently machining continues to be an crucial a part of factor manufacture. additionally, for heaps elements, the producing of right surface end is crucial [5–7]. Inside the last decade, the use of fly ash reinforcements has been elevated due to their low value and availability as waste derivative in thermal electricity flowers. It increases the electromagnetic defensive impact of the Al MMC [8]. all the exclusive particulates or fibres utilized in composites have exclusive residences and so affect the homes of the composite in specific approaches: high strength, Ease of fabrication and low value[9] Stir casting approaches additionally beautify the bonding electricity among the strengthened particles and matrix due to its higher stirring motion. The major problem with the stir casting is segregation or dusting of reinforced debris due to the fact after wetting some debris sink of float due to density distinction during solidification. due to this many casting defects like porosities, blow holes and inclusion may additionally arise. [10]

II. EXPERIMENTAL PROCEDURE

A.STIR CASTING

Stir casting is a liquid state method for the fabrication of composite materials, in which a dispersed phase is mixed with a molten matrix metal by means of mechanical stirring. Stir Casting is the simplest and the most cost effective method of liquid state fabrication. Al_2O_3 particles were observed to refine the grains and were distributed homogeneously in the aluminium matrix. Al_2O_3 particles clusters were also seen in a few places.Al_2O_3 particles were properly bonded to the aluminium matrix.
The reinforcement of Al_20_3 particles improved the micro hardness and ultimate tensile strength of AMMC.

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Fig-1- After Stir Casting

The cylindrical Al_2O_3 reinforced AA6061 are cast by stir casting method which have 8% of Al_2O_3 in it. Cast AMMCs samples are shown in the (fig-1) are fabricated for machining purpose. The tests of specimens is carried out in a conventional universal lathe machine (Padman student: machine tool traders madras)

B.Turning Operation

The turning operation have done on the cast AMMC work piece as shown in the FIG-2.

Total 9 turns at constant depth of cut, varying three different speeds and feed rates accordingly

Fig-2: After Turning Operation

Cutting tool	Silicon carbide
Speed RPM	500-775-1200
Feed rate(mm/rev)	0.04-0.08-0.16
Depth of cut(mm)	0.5(constant)

Table-1

III. RESULT AND DISCUSSION

A.Cutting Forces

With in the present investigation, during dry turning operations has performed to evaluate the cutting forces. when the device is in reduce, a tangential and a radial component of the reducing pressure will try and deflect the tool far from the centre line. In doing so, the device clearance attitude might be decreased. Any radial deflection approach that the reducing depth as well as the chip thickness is decreased which can result in vibration tendencies. After the machining of AMMC the result indicates that the reducing pace increases on increasing the feed rate and rpm and also reducing forces increases on growing the slicing speed at constant feed and intensity of reduce at distinct spindle velocity.

Fig-3-Dynamometer

Cutting forces are find out from the cutting speed and wattmeter readings (taken from the dynamometer shown in the fig-3).

B.Chip Formation

Machining is a procedure of slow removal of excess cloth from the preformed blanks inside the shape of chips. The form of the chips is an essential index of machining as it without delay or in a roundabout way shows : Nature and behaviour of the paintings material underneath machining condition, specific strength requirement (amount of strength required to do away with unit volume of work cloth) in machining paintings, Nature and degree of interaction on the chip-device interfaces. The shape of machined chips rely mainly upon: paintings fabric, material and geometry of the reducing tool, ranges of cutting velocity and feed and also to some extent on depth of cut, Machining surroundings or slicing fluid that impacts temperature and friction at the chip-tool and work-device interfaces. The chip formation for the period of machining has followed via terribly severe plastic deformation at shear space and thanks to the shortage of adequate malleability of the paintings material. The addition of Al2O3 made a semi-non-stop type of carve some purpose of machining of those AMMCs with out chip breaker. this might be helpful to the machinability issue of read. It now not best improves the machinability of this composite, but additionally enhances its pertinency in various industries. the scale of chips has in addition sick with the proportion of reinforcement particles in cast AMMC.

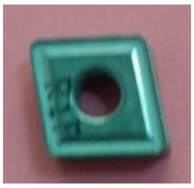
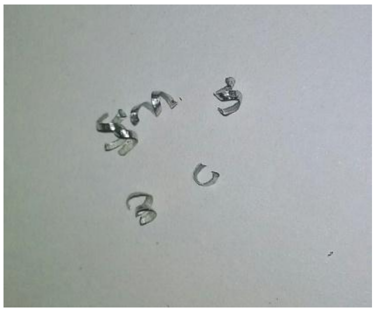


Fig 4

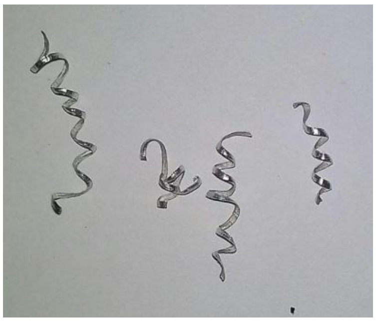
Silicon carbide tool is used for the turning operation, since it is having a high melting point of 2,730°c it is used as a cutting tool for hard materials like aluminium metal matrix composites

C.Different types of chips at different speed&feed in turning operation are given below at depth of cut 0.5 mm (constant)



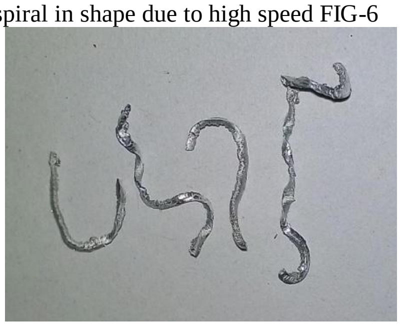
(fig-5: speed-500, feed-0.04)

At speed 500rpm & feed rate 0.04 chips are formed in very small size. This is due to the speed & chips formed are not continues, they were broken into small pieces FIG-5



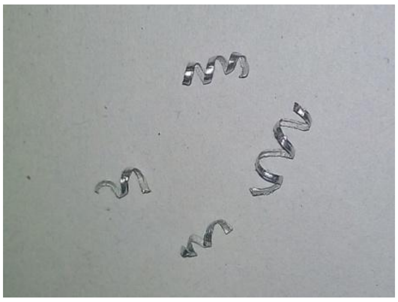
(fig-6: speed-775, feed-0.04)

At speed 775rpm & feed rate 0.04 chips formed are long and most of them are spiral in shape due to high speed FIG-6



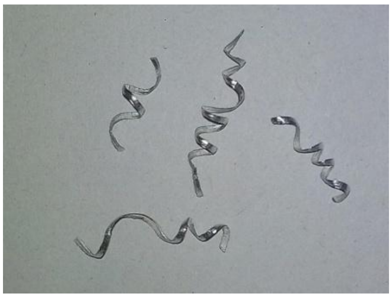
(fig-7: speed-1200, feed-0.04)

At speed 1200rpm & feed rate 0.04 chips are formed longer and irregular in shape due to its high speed factor and most of the chips were not broken and are continuously long.FIG-7



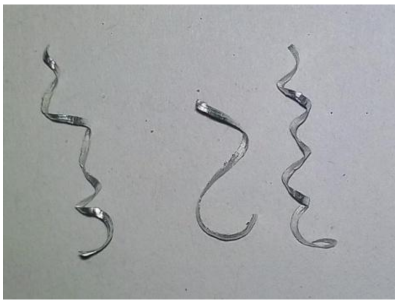
(fig-8: speed-500, feed-0.08)

At speed 500rpm & feed rate 0.08 chips are formed a bit longer comparative to the same speed and varying feed rate of 0.04. FIG-8.



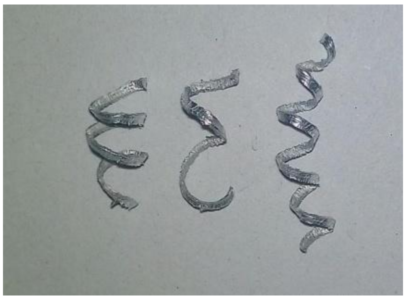
(fig-9: speed-775, feed-0.08)

At speed 775rpm & feed rate 0.08 chips formed are brittle comparative to the same speed but varying feed rate of 0.04 FIG-9.



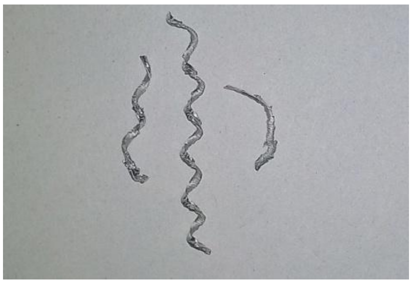
(fig-10: speed-1200, feed-0.08)

At speed 1200rpm & feed rate 0.08 chips formed are spiral in shape unlike to the same speed but varying feed rate of 0.04 FIG-10



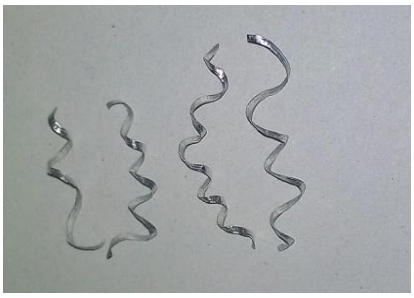
(fig-11:speed-500,feed-0.16)

At speed 500rpm & feed rate 0.16 chips formed are longest at this speed due to its feed rate comparative to the same speed and varying feed rate of 0.04 & 0.08



(fig-12: speed-775, feed-0.16)

At speed 775rpm & feed rate 0.16 chips formed are often broken and mostly are irregular in size average when compared to the same speed and varying feed rate of 0.04 & 0.08 .FIG-12



(fig-13: speed-1200, feed-0.16)

At speed 1200rpm & feed rate 0.016 chips formed are similar in size and are broken easily comparative to the same speed and varying feed rate of 0.04 & 0.08 .FIG- 13.

Graphs

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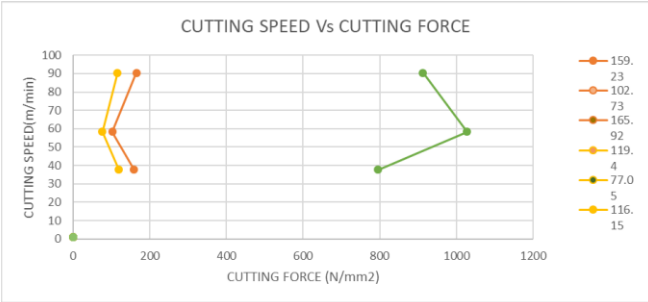
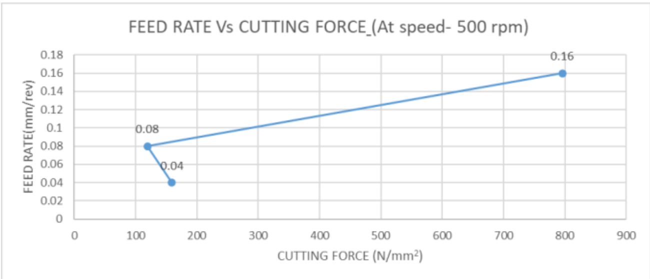
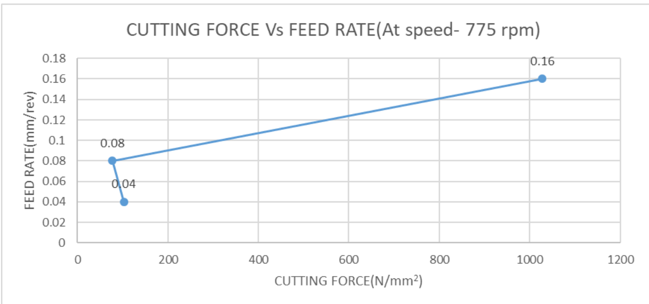


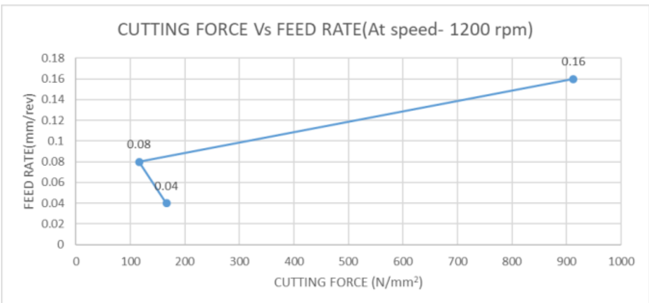
We observe that cutting speed and cutting force are inversly proportional as if one parameter increases ,the other parameter decreases oftenly.



The results show that cutting force decreased with increasing speed while increasing feed rate increased cutting forces.



Results show that cutting force increases with increasing depth of cut and feed rate



Cutting force increases with increasing depth of cut and feed rate. Hence, there is no major change because there is constant depth of cut and slight variations due to varying feed rate.

IV. CONCLUSIONS

The following consequences had been crafted from the existing work:

- while the feed charge is increasing, the slicing forces are growing at constant intensity of cut
- even as growing the reducing speed, the cutting forces are increasing at constant depth of cut

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1. 8.B. Vijaya Ramnath1, C. Elanchezhian1, RM. Annamalai1, S.Aravind1,T. Sri Ananda Atreya1, V.Vignesh1 and C.Subramanian2 1Department of Mechanical Engineering, Sri Sairam Engineering College, West Tambaram,Chennai-600 044, India ;2 Department of Mechanical Engineering, Shinas College of Technology, Oman
8. Machinability Investigation of Aluminium Based Hybrid Metal Matrix CompositeP.Vinoth Kumar1, S.Birundha Devi2, G.Gowshikan3, B.Balamuali4 -P.G Student, Dept of Mechanical Engineering, SNS College of Engineering, Coimbatore, India