

Surface Quality of Jute Fibre Reinforced Polyester Composite by Abrasive Waterjet Machining

Kalirasu S., Rajini N., Rajesh S., Gopikumar S., Arunkumar K., Mukesh Vaidya C. M.

Abstract: *Unpleasantness in the job assumes an essential job in distinguishing manner that is how the genuine item cooperates with the encompassing world in the field of engineering. The Harsh surface gets wear easily and quickly, so consequently, the article producing area needs to get a mass in it. Nowadays composite assumes a vital job due to some great properties. Along these lines, composite needs to get more focus in its new trend. In cutting innovation, the instrument wear is the most important factor that should be considered. There is some non-customary machining process in which the cutting instrument isn't utilized in it. In this technique we utilize Abrasive water jet machine (AWJM) since it is a standout most utilized non-customary machining process, which has no cutting tools and the blend of rough molecule of garnet 80 mesh and high-pressure water from the spout is utilized to cut the workpiece with some of the parameters like grating stream rate, remain off separation, feed rate and siphon weight. The jute fiber reinforced unsaturated polyester composite (JF/UPR) created by pressure forming which is utilized for estimating surface Roughness (Ra) and furthermore to locate the base surface unpleasantness by changing the three distinct parameters of pressure (P), Standard of distance (S_d) and feed rate (V_f) with the predetermined evaluation of grating molecule.*

Keywords: Composite, AWJM, Surface roughness.

I. INTRODUCTION

Water jet machining, a high-velocity water jet is passed to strike a workpiece. During this process, high-pressure energy is converted to kinetic energy. Later on, abrasives are added. This high-pressure water jet is used for cutting high strength and hard materials. The water jet process provides many unique capacities and advantages to reduce cost. Water jet technology is the fastest growing technology in the world. Toxic fumes, recast layers, slag, and thermal stress are totally eliminated. Cutting forces are less and no heat affecting zone near the cutting area [1-3]. [4] It has been reported that the layered composites are difficult to machine as it is heterogeneous due to the matrix properties, fiber orientation and relative volume fraction of matrix.

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AWJM has proven to be a viable technique to machine such materials compared to conventional machining. [5] Comparative study of unidirectional graphite/epoxy composite material has been machined by water jet and AWJM processes. Based on previous studies AWJ machining is found to be a more feasible machining process for unidirectional graphite/epoxy due to its material removal mechanisms, and superior quality surface generation. [6] It is also an effective technology for processing metallic coated sheet steels with good key quality and commercially acceptable productivity. [7, 8] The cutting stroke in AWJM is influenced by the grain size of the abrasive powder. [9] Even though with the help of water the cutting of material can be done but for harder materials, the abrasives should be added. [10] The pressure of water depends upon the area of the nozzle that is used. [11] There is the various size of abrasive grain size is available. As per the factors the size of grain size can be selected. [12] The quality of machining is determined by the surface finish of the materials. [13] The average surface thickness of 6mm can be machined using AWJM. [14] The velocity and pressure of the water is the important factor that is considered in the AWJM. [15] Abrasive used, Grain size of the abrasives are some other factors that should be considered for AWJM.

II. EXPERIMENTAL DETAILS

A. Materials used

Jute fibers are used for the fabrication of plate. To reinforce the fiber, polyester resin is applied which has a density of 1.9 to 2.0 kg/dm³. These were supplied by vasavibala resins (P) Ltd, Chennai.

B. Preparation of composite

The jute fiber is cut into the shape of the mould in size of 30×13 cm and then polished wax is applied over the moulds to remove the plate after fabrication with ease and then the required amount of polyester resin is taken. The jute fiber of 163g is placed in the mould cavity and the polyester resin is gradually spread over the jute fiber and it is covered by upper mould. And it is subjected to compression moulding about to a pressure of 120 psi and it takes around 4 hours for curing time. After curing of fiber it is been removed off from the compression moulding the excess resins and fibers are been trimmed off. And the plate that we required for the testing has been obtained at the weight of 555g. The percentage of jute fiber is calculated by dividing the weight of fiber by composite weight we obtain 30%. Now, this can be used for the next process.

III. MACHINING AND MEASUREMENTS

A. Cutting of plate through AWJM

Figure 1. Shows the AWJM nozzle setup with abrasive feeder. The manufactured jute fiber plate is set on the work table of AWJM machine with the accessibility of determined garnet 80 mesh grating particles with a blend of water for cutting the plate according to the given contribution of pressure, feed rate, stand-off distance. The plate has been cut into 54 bits of 2cm to quantify the surface unpleasantness of the plate by shifting the above parameters.

B. Measurement of Surface Roughness



Fig. 1. Abrasive Water Jet Machine



Fig. 2. Surface Roughness Testing Machine

Figure 2. Shows the surface roughness testing machine. The surface roughness of the created JF/UPR composite is dictated by surface roughness testing machine. Spot the estimating test legitimately and look at it with no blunder. Place the workpiece on the table and now modify the agent to contact tip of the fiber up to the sign of the green light and furthermore give contribution of length of material for recognizable proof reason for the machine is up to 20mm and now begin the machine and now the test moves from the one end to opposite end and holds to the beginning stage. Now the readings are shown in the screen according to this following the rest of the readings are been noted lastly the 54 distinct qualities are

been framed as table configuration for simple distinguishing proof of the estimating of least surface harshness of the predefined grating molecule on these composite materials.

Table - I: Parameters and Levels

S.No	Parameters	Levels		
		1	2	3
1.	P (Mpa)	150	200	250
2	S _d (mm)	1	2	3
3	V _f (mm/s)	20	30	40

Table – II: Surface Roughness Readings

P (Mpa)	S _d (mm)	V _f (mm/s)	Ra (µm)
250	1	20	0.07
250	1	30	0.12
250	1	40	0.18
250	2	20	0.07
250	2	20	0.13
250	3	20	0.18
150	1	20	0.15
200	1	20	0.10
250	1	20	0.07

Table I. demonstrates the information given to the machine so as to locate the Ra of JF/UPR composite, the objective to distinguish the Ra with various information parameters with the assistance of AWJM. JF/UPR composite with the elements of 30 cm x 13 cm which is set in AWJM with some coordinated joints. In this manner, the plate is fixed. Finally, the pressure, V_f, S_d has been referenced in the table as a consequence of information parameter dependent on the esteem, the Ra is acquired. Every single feed rate has diverse surface harshness, along these lines when each info parameters change as per that surface unpleasantness will get differed base on the information which was given. Table II. Demonstrates the parameters and levels which are the distinctive parameters with the diverse dimensions have been done on our task. Because of this analysis, we got three diagrams which shows the connection between the Ra versus three distinct parameters.

IV. RESULT AND DISCUSSION

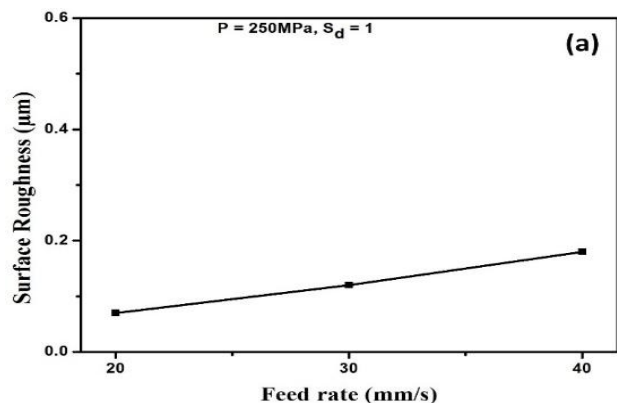


Fig.3(a). Effect of V_f at P = 250MPa, S_d = 1mm

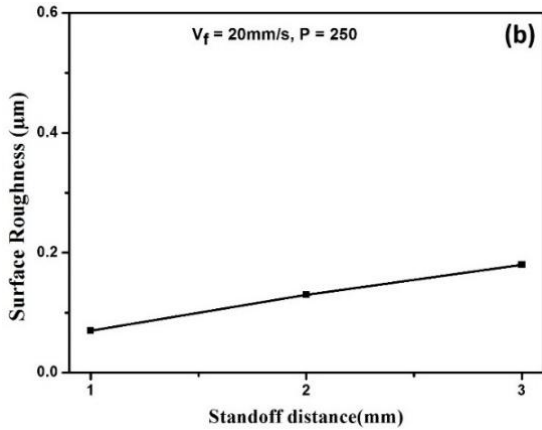


Fig.3(b). Effect of Sd at P = 250MPa, Vf = 20mm/s

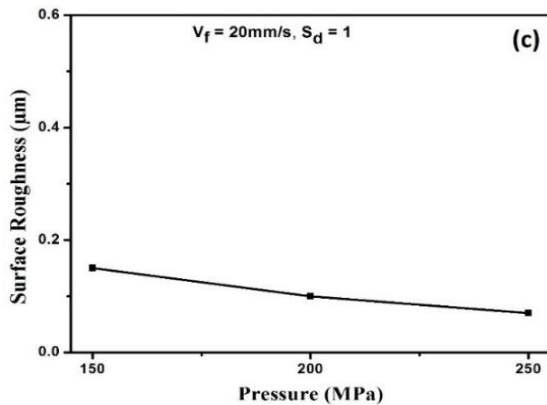


Fig.3(c). Effect of Pressure at Sd = 1mm, Vf = 20mm/s

Figure 3(a) speaks to the connection between the Ra versus feed rate. This diagram demonstrates the three diverse feed rate with some particular parameters to know the surface unpleasantness. This chart has obviously demonstrated that if the feed rate builds the surface unpleasantness will get expanded, when the information parameters with the weight 250MPa, S_d 1mm, and the material is jute fiber strengthened with polyester resin. To accomplish the surface smoothness, the feed rate should be diminished. This implies the feed rate must be some particular however principle downside of this parameter, as feed rate decline the cutting time will get diminished. It prompts hinder the assembling procedure. It implies time utilization is high.

Figure 3(a) The Representation of the graph denotes that if the feed rate is increased the Ra of the material is also been increased

Figure 3(b) speaks to the connection between the Ra versus S_d. This chart demonstrates the near incentive with three diverse remain off separation with some particular parameters. This diagram has obviously demonstrated that in the event that they remain off separation expands, at that point the surface harshness will get expanded, when the info parameters with the weight 250MPa, feed rate 20mm/s and the material is JF/UPR composite. To accomplish the surface smoothness, remain off separation should be diminished. This implies the S_d must be some particular however fundamental downside of this parameter, as remain off separation decline the cutting time will get diminished as same as feed rate versus surface harshness. By and by time utilization is high with the remain off separation parameter. These two-parameters results in tedious however the third parameter is unique. Weight is unique in relation to the other two parameters. With these two parameters, we can say that

the rough water fly machining isn't reasonable for composite materials.

Figure 3(b) The representation of the graph denotes that if the standoff distance is increased the surface roughness of the material is also increased.

Figure 3(c) The Representation of the graph denotes that if the pressure is increased the surface roughness of the material is been reduced.

Figure 3(c) speaks to the connection between the Ra versus Pressure. This chart demonstrates the three distinct weights with some particular parameters to know the surface harshness. This diagram has unmistakably demonstrated that if the weight builds the surface harshness will get diminished when the information parameters with the feed rate 20mm/s, S_d 1mm, and the material is JF/UPR composite. Surface smoothness has been accomplished. This demonstrates whatever the feed rate and S_d the weight should be more explicit than others. Weight is the exceptional parameter, with this we can say that the composite materials can be prepared in rough water fly machining. This will build the assembling time. In this way, time utilization is less. At that point by deciding every one of the three parameters pressure (250 MPa), S_d (1mm) & feed rate (20 mm/s) we found the base surface unpleasantness on this jute fiber.

V. CONCLUSION

From testing the specimen, the JF/UPR composite material we have discovered that by changing the feed rate and other parameters during machining leads to a staying steady state. We noticed an expansion in feed rate likewise expands the surface hardness of the material. At that point, by differing the S_d and different parameters staying steady we noticed an expansion in S_d likewise an expanding in the surface roughness of the material. At that point by shifting the weight and the other parameters stay steady and there we found the expansion in the weight and the other factors diminishes in the surface harshness. At that point by deciding every one of the three parameters pressure (250MPa), S_d (1mm) & V_f (20mm/s) we found the base surface hardness on this JF/UPR composite.

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