Hindawi
Advances in Materials Science and Engineering
Volume 2023, Article ID 9795165, 1 page
https://doi.org/10.1155/2023/9795165

Retraction

Retracted: Parameters Optimization of Dissimilar Friction Stir Welding for AA7079 and AA8050 through RSM

Advances in Materials Science and Engineering

Received 26 December 2023; Accepted 26 December 2023; Published 29 December 2023

This article has been retracted by Hindawi, as publisher, following an investigation undertaken by the publisher [1]. This investigation has uncovered evidence of systematic manipulation of the publication and peer-review process. We cannot, therefore, vouch for the reliability or integrity of this article.

Please note that this notice is intended solely to alert readers that the peer-review process of this article has been compromised.

Wiley and Hindawi regret that the usual quality checks did not identify these issues before publication and have since put additional measures in place to safeguard research integrity.

We wish to credit our Research Integrity and Research Publishing teams and anonymous and named external researchers and research integrity experts for contributing to this investigation.

The corresponding author, as the representative of all authors, has been given the opportunity to register their agreement or disagreement to this retraction. We have kept a record of any response received.

References

[1] M. Kavitha, V. M. Manickavasagam, T. Sathish et al., "Parameters Optimization of Dissimilar Friction Stir Welding for AA7079 and AA8050 through RSM," *Advances in Materials Science and Engineering*, vol. 2021, Article ID 9723699, 8 pages, 2021.

Hindawi
Advances in Materials Science and Engineering
Volume 2021, Article ID 9723699, 8 pages
https://doi.org/10.1155/2021/9723699

Research Article

Parameters Optimization of Dissimilar Friction Stir Welding for AA7079 and AA8050 through RSM

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Received 23 June 2021; Accepted 12 July 2021; Published 17 July 2021

Academic Editor: Samson Jerold Samuel Chelladurai

Aluminium alloy is widely used in engineering application, and it can be classified based on the constituent elements or alloying elements. Aluminium alloy is preferred for the nature of its tensile strength, ductility, and corrosion resistance in this research to make a dissimilar friction stir welding joint of aluminium alloys 7079 and 8050 materials. The tensile strength of the weld joint is estimated by the influence of the response surface methodology approach. The welding is carried out by preferred process parameters with a tool speed of 1000–2500 rpm, tool pin diameter of 2–6 mm, welding speed of 50–300 mm/min, and tool shoulder diameter of 10–20 mm. The ANOVA analysis and the prediction of tensile strength were conducted efficiently. From the RSM analysis, the tool pin diameter mostly modified the output of the result.

1. Introduction

The novel technique joins the material permanently by using the friction stir welding process, and the nonconsumable tool is applied to carry the welding process. One best advantage of the FSW process is, without melting the work samples during welding, heat is introduced between tool rotation and specimens [1–3]. The welding is carried out along the straight line in a longitudinal manner of tool movement to join the samples. The homogeneous mixture is achieved applying the pressure in the joint area (soft region) of the specimens. The FSW process effectively joins all alloys such as aluminium alloys, titanium alloys, copper alloys, magnesium alloys, and steel material by a similar or dissimilar mode. This welding is now fruitfully used in joining polymers, and the FSW process is carried out by Wayne Thomas at TWI Ltd. in 1991 [4–6]. Most of the aluminium alloy is used in the ship building, automotive segment, and aerospace sectors. The different tool profiles are used in friction stir welding as cylindrical, square triangular, and threaded, and the tool rotates and passes through a straight line mode [7]. The shoulder diameter is big in size compared to tool pin diameter, and the pin of the tool plunges into work pieces effectively [8]. The pin rotates at high speed with intercombination of materials carried out efficiently. The microstructure changed by means of stirring action; it causes the swap of particles from one material to another one remarkably. The strength of the joint is increased, and to form a rigid structure, the study of different zones in the welded area is very important in the friction stir welding process. In arc welding, gas welding and other types of the welding process formed lot of defects, but this FSW process eliminates or minimizes the welding defects if using any material with various parameters [9]. The FSW process is mainly used to make butt joint, eventhough lap joints are also carried in the FSW process. For the past research, the dissimilar friction stir welding of AA7079 and AA8050 is through response surface methodology. The influence of different process parameters is to evaluate the tensile strength of the weld joint successfully. RSM is a statistical technique to find the optimal parameters and the maximum range of the output value [10–12].

2. Materials

The friction stir welding process planned to make dissimilar aluminium alloy materials such as AA7079 and AA8050. The chemical composition of both the materials is tabulated with their weight percentage in Table 1.

The aluminium alloy 7079 has a wrought alloy with a heat treatable mode, and it has extraordinary strength. It possesses good machinability and workability characters; this alloy is mainly used in the high stressed parts. In the air wings parts, this alloy played a major role in hydraulic function units. The AA8050 aluminium alloy has good strength easy to modify any shape; it has high corrosion resistance behaviour. This alloy can be used in the body building industries.

3. Experimental Procedure

The FSW process considers the process parameters, and all the factors and their values are given in Table 2.

The factors are tool speed (1000–2500 rpm), tool pin diameter (2–6 mm), welding speed (50–300), and shoulder diameter (10–20). The friction stir welding process specimens prepared under the dimensions are 100*50*5 mm for each plate [13]. The straight cylindrical profile tool and the material of HSS tool is used to weld the specimen effectively (Figure 1). The CNC vertical milling machine was used to weld the samples under the various parameters [14]. The specimens are rigidly fixed on the fixture with the proper clamp, the tool rotated above the top surface of the specimens, and the axial force is applied to the tool. The tool rotated clockwise direction, moved, and penetrated the samples in longitudinal direction, and the weld joint was produced accurately. The tensile test was conducted by the influence of UTM machine.

Table 1: Chemical composition of AA7079 and AA8050.

Material	% of composition of AA7079	% of composition of AA8050
Cr	0.2	0.05
Cu	0.6	0.05
Fe	0.2	1.2
Mg	3.5	0.05
Mn	0.25	0.85
Si	0.25	0.03
Zn	4.0	0.1
Ti	0.7	—
Al	Remaining	Remaining

Table 2: FSW factors and its values.

Notation	Factors	Low	High
A	Tool speed (rpm)	1000	2500
B	Tool pin diameter (mm)	2	6
C	Welding speed (mm/min)	50	300
D	Shoulder diameter (mm)	10	20

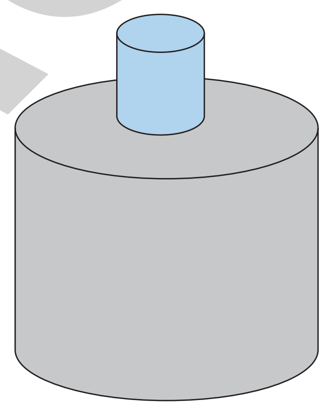

Figure 1: FSW cylindrical tool.

4. Result and Discussion

The code value of the experiment, the process factors contribution, and the result of the tensile strength are given in Table 3.

In Table 4, the ANOVA linear model produced the major contribution of tool pin diameter as 6.38% [15]. In the square model, the tool pin diameter ∗ tool pin diameter has contributed at 26.33%, and in the 2-way interaction model, the tool speed (rpm) ∗ tool pin diameter (mm) has the higher percentage contribution such as 6.13%

Figure 2 shows the maximum tensile strength 212 MPa obtained by the influence of tool speed of 1750 rpm, tool pin diameter of 4 mm, welding speed of 300 mm, and shoulder diameter of 20 mm.

Table 3: FSW factors contribution and the result of tensile strength.

Experiment no.	A	B	C	D	Tool speed (rpm)	Tool pin diameter (mm)	Welding speed (mm/min)	Shoulder diameter (mm)	Tensile strength (MPa)
1	0	0	0	0	1750	4	175	15	162
2	1	0	0	−1	2500	4	175	10	150
3	1	0	0	1	2500	4	175	20	190
4	0	1	0	−1	1750	6	175	10	92
5	0	−1	0	1	1750	2	175	20	110
6	1	1	0	0	2500	6	175	15	196
7	−1	0	−1	0	1000	4	50	15	208
8	0	−1	−1	0	1750	2	50	15	79
9	0	−1	1	0	1750	2	300	15	125
10	−1	0	0	1	1000	4	175	20	184
11	−1	1	0	0	1000	6	175	15	124
12	1	0	−1	0	2500	4	50	15	157
13	0	0	1	1	1750	4	300	20	212
14	−1	−1	0	0	1000	2	175	15	130
15	1	−1	0	0	2500	2	175	15	90
16	0	1	0	1	1750	6	175	20	186
17	0	−1	0	−1	1750	2	175	10	85
18	0	0	−1	−1	1750	4	50	10	176
19	−1	0	1	0	1000	4	300	15	146
20	0	0	0	0	1750	4	175	15	85
21	0	0	−1	1	1750	4	50	20	192
22	0	0	0	0	1750	4	175	15	156
23	0	1	−1	0	1750	6	50	15	137
24	0	1	1	0	1750	6	300	15	82
25	1	0	1	0	2500	4	300	15	97
26	0	0	1	−1	1750	4	300	10	211
27	−1	0	0	−1	1000	4	175	10	173

Table 4: Analysis of variance summary.

Source	DFF	Seq SS	Contribution (%)	Adj SS	Adj MS	F value	P value
Model	14	34385.4	67.19	34385.4	2456.10	1.76	0.167
Linear	4	7264.5	14.19	7264.5	1816.12	1.30	0.325
Tool speed (rpm)	1	602.1	1.18	602.1	602.08	0.43	0.524
Tool pin diameter (mm)	1	3267.0	6.38	3267.0	3267.00	2.33	0.152
Welding speed (mm/min)	1	481.3	0.94	481.3	481.33	0.34	0.568
Shoulder diameter (mm)	1	2914.1	5.69	2914.1	2914.08	2.08	0.175
Square	4	19976.9	39.03	19976.9	4994.23	3.57	0.039
Tool speed (rpm)*tool speed (rpm)		1385.6	2.71	1415.6	1415.56	1.01	0.334
Tool pin diameter (mm)*tool pin diameter (mm)		13475.0	26.33	6471.3	6471.26	4.62	0.053
Welding speed (mm/min)*welding speed (mm/min)	1	59.6	0.12	960.0	960.04	0.69	0.424
Shoulder diameter (mm)*shoulder diameter (mm)	1	5056.7	9.88	5056.7	5056.68	3.61	0.082
2-way interaction	6	7144.0	13.96	7144.0	1190.67	0.85	0.556
Tool speed (rpm)*tool pin diameter (mm)		3136.0	6.13	3136.0	3136.00	2.24	0.160
Tool speed (rpm)*welding speed (mm/min)	1	1.0	0.00	1.0	1.00	0.00	0.979
Tool speed (rpm)*shoulder diameter (mm)	1	210.2	0.41	210.3	210.25	0.15	0.705
Tool pin diameter (mm)*welding speed (mm/min)	1	2550.2	4.98	2550.2	2550.25	1.82	0.202
Tool pin diameter (mm)*shoulder diameter (mm)	1	1190.2	2.33	1190.3	1190.25	0.85	0.375
Welding speed (mm/min)*shoulder diameter (mm	1	56.2	0.11	56.2	56.25	0.04	0.844
Error	12	16793.8	32.81	16793.8	1399.48		
Lack of fit	10	13125.1	25.65	13125.1	1312.51	0.72	0.708
Pure error	2	3668.7	7.17	3668.7	1834.33		
Total	26	51179.2	100.00				

5. Prediction for Tensile Strength (MPa)

The regression equation in uncoded units is given as follows. Tensile strength (MPa) = 533 − 0.215 tool speed (rpm) + 37.1 tool pin diameter (mm) + 0.133 welding speed (mm/min) − 43.1 shoulder diameter (mm) + 0.000029 tool speed (rpm) ∗ tool speed (rpm) − 8.71 tool pin diameter (mm) ∗ tool pin diameter (mm) + 0.00086 welding speed (mm/min) ∗ welding speed (mm/min) + 1.232 shoulder diameter (mm) ∗ shoulder diameter (mm) + 0.0187 tool speed (rpm) ∗ tool

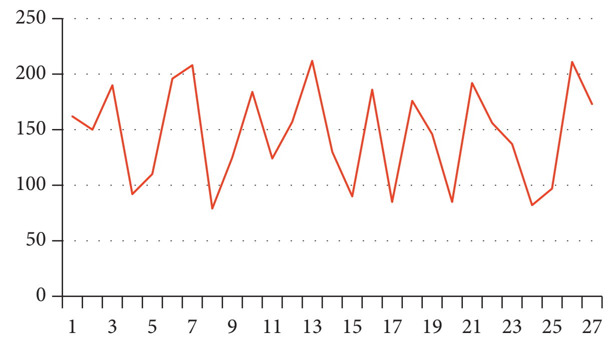

Figure 2: Number of specimens vs. tensile strength.

Table 5: Response optimization parameters and values setting.

Response optimization	Tensile strength (MPa)
Parameters	Tool speed (1000 rpm) Tool pin diameter (2 mm) Welding speed (50 mm/min) Shoulder diameter (10 mm)
Goal	Tensile strength (MPa) maximum
Response importance tensile strength (MPa)	Lower 79 Target 212 Upper 1 Weight 1

Table 6: Response optimization.

Tool speed (rpm)	Tool pin diameter (mm)	Welding speed (mm/min)	Shoulder diameter (mm)	Tool strength (MPa)
1000	2.344	300	10	211.428

Table 7: Prediction for tensile strength (MPa).

Multiple response prediction				
Variable setting				
Tool speed (rpm)	1000 rpm			
Tool pin diameter (mm)	2.44440 mm			
Welding speed (mm/min)	300 mm/min			
Shoulder diameter (mm)	10 mm			
Response	Fit	SE fit	95% CI	95% PI
Tensile strength (MPa)	211.4	51.1	(100.0, 322.9)	(73.4, 349.5)

pin diameter (mm) + 0.000005 tool speed (rpm) ∗ welding speed (mm/min) + 0.00193 tool speed (rpm) ∗ shoulder diameter (mm) − 0.1010 tool pin diameter (mm) ∗ welding speed (mm/min) + 1.72 tool pin diameter (mm) ∗ shoulder diameter (mm) − 0.0060 welding speed (mm/min) ∗ shoulder diameter (mm).

6. Solution

Tables 5 and 6 illustrate the response optimization parameters and values setting and response optimization of tensile strength, respectively, and there are four factors involved for this experiment. Table 7 presents the prediction for tensile strength (MPa) and the values.

The numerical response optimizer used to create an optimal set of factors involving to offer the maximum tensile strength is shown in Figure 3. In this study, the main target of the result is to maximize the tensile strength. From the graph, it involves predicting tensile strength as the optimum factor of tool speed of 1000 rpm, tool pin diameter of 2.4 mm, welding speed of 300 mm/min, and shoulder diameter of 10 mm, offering the maximum tensile strength of 211.48 MPa.

Figure 4 shows the maximum tensile strength obtained by interaction of pin diameter, the tool speed has fixed as 1700 rpm, the tool pin has 4 mm diameter, and the maximum tensile strength was obtained as 170 MPa. In this experiment, Figure 5 illustrates the maximum tensile

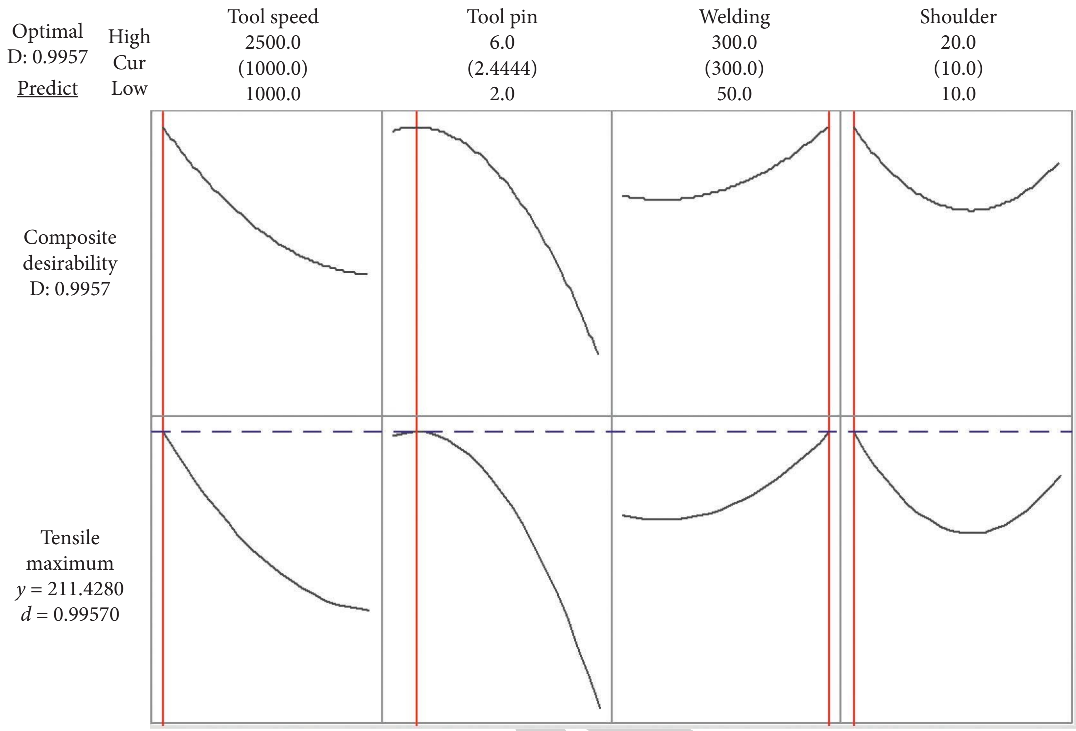

FIGURE 3: Numerical response optimizer graph.

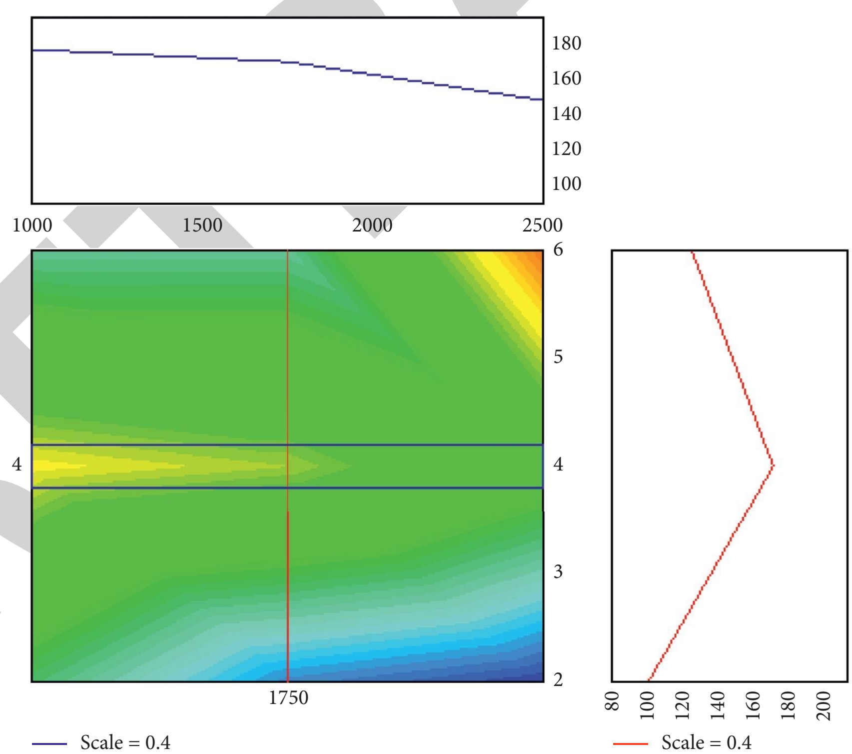

FIGURE 4: Tool speed graph, tool pin diameter vs. tensile strength.

strength offered by the welding speed interaction, the tool pin diameter is fixed as 4 mm, welding speed is 175 mm/min, and the maximum tensile strength obtained is 160 MPa. The welding speed graph in Figure 6 shows that the welding speed has fixed as 175 mm/min, the maximum tensile strength produced by shoulder diameter interaction. The shoulder diameter of 15 mm influenced to produce the maximum tensile strength as 138 MPa.

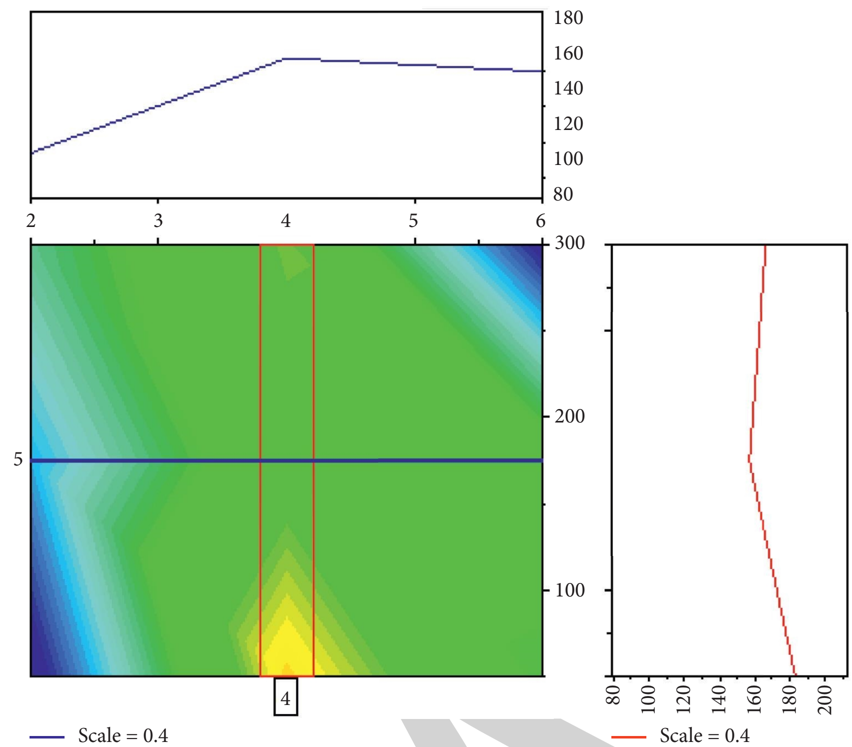

Figure 5: Tool pin graph, welding speed vs. tensile strength.

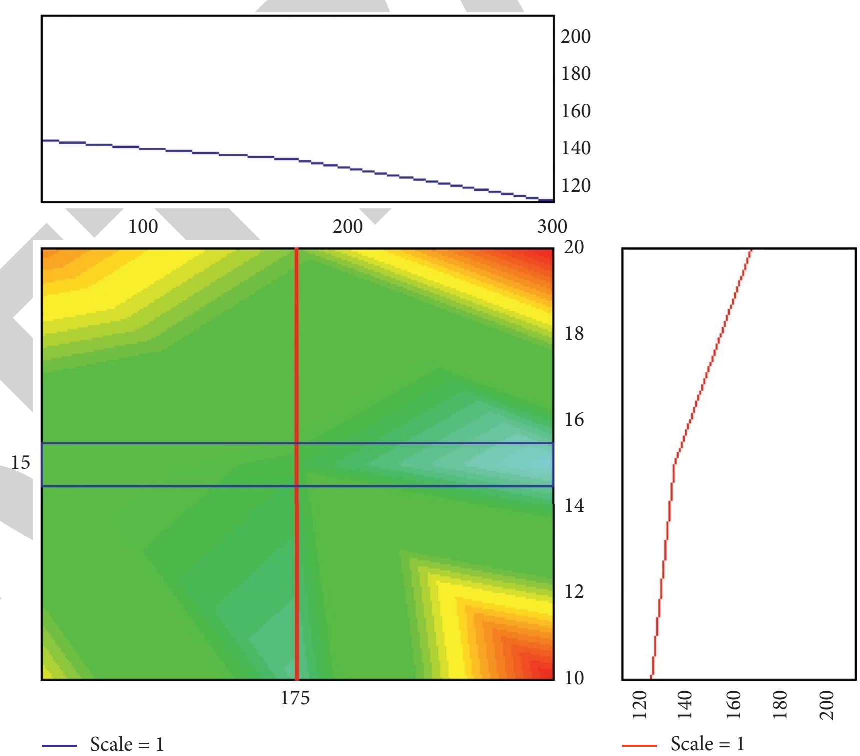

Figure 6: Welding speed graph, shoulder diameter vs. tensile strength.

7. Conclusion

The dissimilar friction stir welding of AA7079 and AA8050 aluminium alloy jointed efficiently applying straight cylindrical tool. The response surface methodology was implemented to find the maximum tensile strength and the optimal parameters. The output of this experiment is drawn as follows:

(1) From the analysis of variance, in the liner model, the major contribution of tool pin diameter was 6.38%, in the square model, the tool pin diameter ∗ tool pin diameter has contributed at 26.33%, and in the 2-way interaction model, the tool speed (rpm) ∗ tool pin diameter (mm) has the higher percentage contribution such as 6.13%

(2) The maximum tensile strength 212 MPa was obtained by the influence of tool speed of 1750 rpm, tool pin diameter of 4 mm, welding speed of 300 mm, and shoulder diameter of 20 mm

(3) For the predicted analysis, the optimum factor of tool speed of 1000 rpm, tool pin diameter of 2.4 mm, welding speed of 300 mm/min, and shoulder diameter of 10 mm offered the maximum tensile strength of 211.48 MPa. The predicted tensile strength and the response optimized tensile strength values are near, since the four factors and the values of this evaluation were good.

(4) Further scope of this study was extended to conduct friction stir processing (FSP) to modify the surface structure of the dissimilar materials

Data Availability

The data used to support the findings of this study are included within the article, and further data or information required is available from the corresponding author upon request.

Disclosure

It was performed as a part of the employment of Bule Hora University, Ethiopia.

Conflicts of Interest

The authors declare that there are no conflicts of interest.

Acknowledgments

The authors appreciate the supports from Bule Hora University, Ethiopia, and thank Saveetha School of Engineering, Chennai, for the technical assistance to complete this experimental work.

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