

Study and Analysis of Axial shortening of friction welded joints of Nylon cylindrical rounds

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Abstract: Friction welding is a solid state welding which is used to weld similar and dissimilar joints without many defects. Nylon plays an important role in aeronautical and automotive applications. In this work nylon rounds are welded by friction welding process with different weld parameters such as Friction pressure, upset pressure and Friction time. L₉ Orthogonal array is designed to conduct experiment which provides 3 levels and 3 factors. In this experimental work Hardness of friction welded nylon joints are determined. The weld joints are optimized by Taguchi design of experiments and analyzed by ANOVA methodology.

Key words: Friction welding, Weld parameters, Nylon, Hardness, S/N ratio, ANOVA.

1-Introduction; Rotary Friction welding is a solid-state welding process that generates heat through mechanical friction between workpieces in relative motion to one another, with the addition of a lateral force called "upset" to plastically displace and fuse the materials. Because no melting occurs, friction welding is not a fusion welding process in the traditional sense, but more of a forge welding technique. Friction welding is used with metals and thermoplastics in a wide variety of aviation and automotive applications

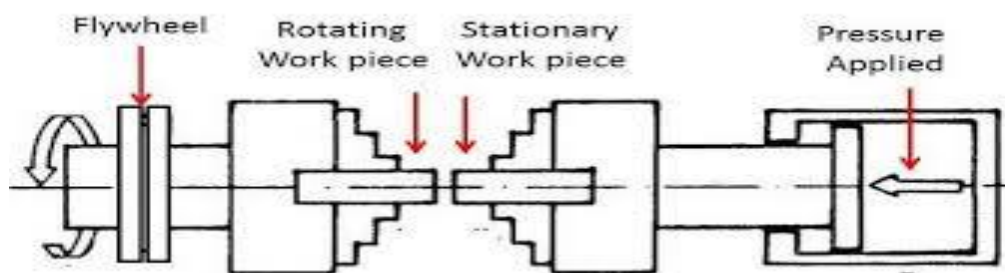


Fig 1 Friction welding

2. Experimentation

In this experiment of friction welding, two nylon rods is selected with the size of 25mm diameter and 100mm length ,total 18 nylon rod is prepared with the required size to weld. The experiment planned to weld 9 joints with help of friction welding lathe machine. The friction welding was performed at 500,800,1000rpm.with the corresponding time of 9, 15 and 25 seconds. The two nylon rods were mounted on the centre of the friction welding machine.and were put in contact with each other for the duration of 9 with the automatic feed of 0.48 mm/rev.welding of these pieces were successful. so welding carried out with different

combinations of rpm, feed rate and time. Hence nine welding has been done to find the good welded joint. The combination of parameters shown in the table 1

Table 1. Friction welding parameters of Nylon rod welding process

Parametric conditions	Rotational speed (rpm)	Feed rate (mm/rev)	Welding time (sec)
1	500	0.48	9
2	500	0.58	15
3	500	0.78	25
4	800	0.48	9
5	800	0.58	15
6	800	0.78	25
7	1000	0.48	9
8	1000	0.58	15
9	1000	0.78	25



Fig 1 HMT model - Friction welding machine



Fig 2 Friction welded joints of Nylon rounds

3. Result and discussion

In this experimental work, prepared Nylon rods are welded by centre lathe (HMT) is shown in figure1 using different weld parameter and 9 welded joints are obtained . All the nine friction welded joints have good strength and weldability property. One end of nylon is fixed with rotating chuck and other end of nylon rod is fixed and allowed to give lateral pressure which is called upset pressure. The friction welded joint of nylon rod is shown in figure 2.

Friction Pressure	Forging Pressure	Friction Time	Hardness Number	SNRA
1	1	1	80	38.0618
1	2	2	85	38.5884
1	3	3	93	39.3697
2	1	2	87	38.7904
2	2	3	88	38.8897
2	3	1	92	39.2758
3	1	3	93	39.3697
3	2	1	91	39.1808
3	3	2	90	39.0849

Table 2 Friction welding parameters of Nylon rounds

Table 2 denotes Friction welding parameter based on L9 orthogonal array. It contains 3 levels (low, medium, High) and 3 factors (Friction pressure, Upset pressure and friction time) which is derived from Taguchi's design of Experiment. The higher Hardness values is achieved in 3rd level of friction pressure (10bar) ,1st level of Upset pressure and 3rd level of Friction time. The larger the best concept is followed in this experiment for getting higher of Hardness in the weld interface. Higher value of signal to noise ratio mention the best welding parameters of friction welding process.

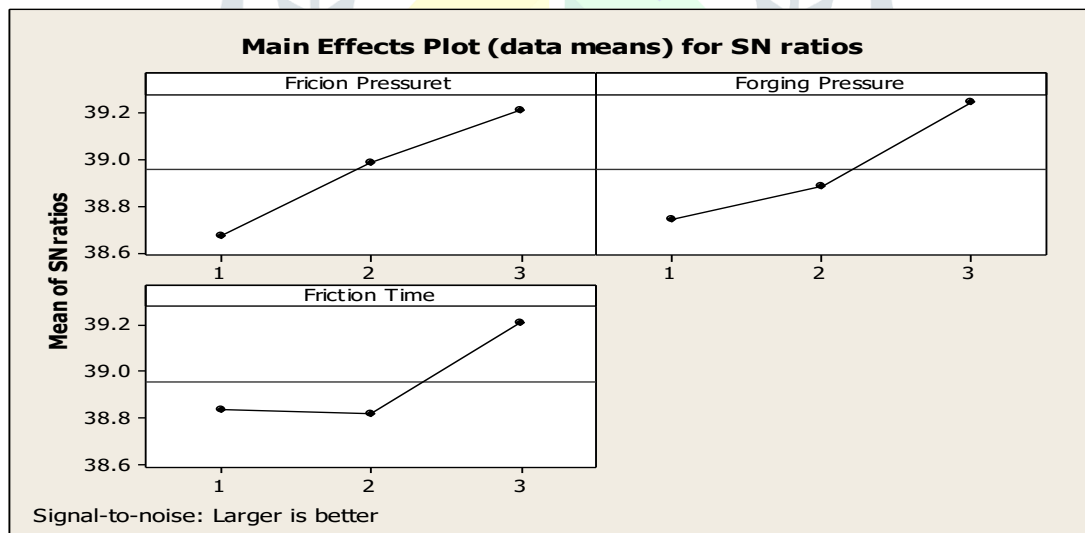


Fig 3 Main effect plot of friction welded parameters

Fig 3 denotes main effects plots for friction welded joints of Nylon which analysis based on signal to noise ratio values. Higher Values of SN ratio mention the influencing levels and factors of welded parameters .Form this graph best Friction pressure in level 3,upset pressure in level 1 and Friction time in level 3 .The concept of signal to noise is larger is best

Table 3 Response Table of welded parameters

Level	Friction Pressure	Forging Pressure	Friction Time
1	38.67	38.74	38.84
2	38.99	38.89	38.82
3	39.21	39.24	39.21
Delta	0.54	0.50	0.39
Rank	1	2	3

Table 3 shows the response table for achieving higher value of hardness between weld interfaces of Friction welded joints of Nylon rounds. It also represents friction pressure is a most influencing parameter then upset pressure and friction time are followed ranks in friction welding process.

Table 4 Analysis of Variance for Hardness Number of Nylon joints

Source	DF	Seq SS	Adj SS	Adj MS	F	P
Friction Pressure	2	42.89	42.89	21.44	1.23	0.449
Forging Pressure	2	40.22	40.22	20.11	1.15	0.464
Friction Time	2	29.56	29.56	14.78	0.85	0.541
Error	2	34.89	34.89	17.44		
Total	8	147.56				

Table 4 shows that most influencing parameter of friction welded joints of nylon rod for achieving better hardness based on higher value of “F” Value. It also confirms 95% of confidential level and mention significance of weld quality through ANOVA components values.

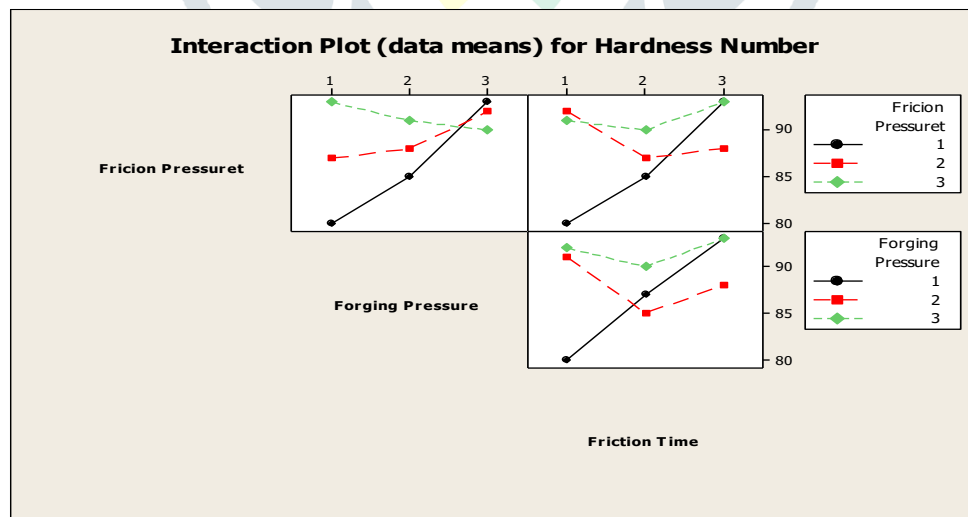


Fig 5 Interaction plot for friction welded joints of Nylon rods

Fig 5 shows that Interaction plot for Friction welded joints of Nylon rods and indicate all welding parameters are dependable and produce good weldability with better hardness values. The weld interface have equal thickness of flash and does not provide any defects.

4. Conclusion

Nylon joints are welded by Friction welding process, it conclude that

1. Nylon joints are provided good weldability property and welded successfully by friction welding process.
2. Nylon joints are welded by solid state and does not provide any defect
3. Optimum parameters of friction welded joints of nylon rods for achieving higher hardness are 10 bar of friction pressure, 15 bars of upset pressure and 6 seconds.
4. Friction welding parameters such Friction pressure, Upset pressure and friction pressure are dependable parameters and perform without slip
5. Friction pressure is an influencing parameter for achieving better hardness in friction welded joints.

6. Reference

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