AIRO JOURNALS
Free / Unpaid
Peer Reviewed
Multidisciplinary
National

ISSN: 2321-3914
Volume:1 Issue: 3
March 2021
Impact Factor: 5.7
Subject Engineering

A STUDY ON PERFORMANCE EVALUATION OF MODIFIED FRICTION DRILLING

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ABSTRACT

Frictional drilling is a craftsmanship and study of making holes in an article, in assembling its assumes a crucial function since over 30% of metal eliminating measure are finished with these sort of tasks. High temperature is created while doing drilling activity, as a result of high temperature producing drill device become dull and prompts decrease device life. The hole making measure by utilizing the structure drilling is a serious cycle. By name one can undoubtedly pass judgment on the contact drilling application. This structure drilling is a cycle of making a holes on the sheet metals by utilizing heat created in rubbing between the hole surface and Tool. As the temperature created is assessed to be in the reach 400-500OC, the apparatus made of rapid steel is chosen for experimentation. With the end goal of experimentation, two apparatuses are picked, one is with an included angle of 30^O and the other is of 60^O.

KEY WORDS: frictional, drilling, temperature, angle, metal.

I. INTRODUCTION

In 1923, the Frenchman Jean Claude de Valière tried making a tool that could make holes in metal by friction heat, instead of by machining. It has been recognized that if enough heat is generated it could melt and form a hole through the metal. With that thought in mind, he developed a special drill designed to increase friction. It was only a moderate success, because at that time the right materials were not yet available. Moreover, the right shape for this type of tool hadn't yet discovered till1980's. Increasing production of automobile industry, pipe industry, development of mechanical products, materials, design of joining in civil engineering force the producers to accelerate the production and to utilize new technologies. Friction drilling, also known as thermal drilling, thermo-mechanical drilling, flow drilling, form drilling, or friction stir drilling, is a nontraditional hole-making method. Drilling plays a very important role in machining since more than 40% of material removal processes are associated with this type of operation. Traditionally, a drilling tool is generally made of

ISSN: 2321-3914
Volume:1 Issue: 3
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Impact Factor: 5.7
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high speed steel (HSS). It generates high temperature during drilling process. Therefore, the drilling tool becomes dull and leads to a shortened service life. Moreover, the work piece materials have been hardened during drilling process which makes the post-process troublesome. Also, the chips adhered to the exit of a drilled hole damages the surface quality and deteriorates the machining precision. Friction drilling, also known as "thermal drilling", "flow drilling", "form drilling", or "friction stir drilling", is the best solution to the aforementioned problems. Friction drilling utilizes the heat generated from the friction between a rotating conical tool and the work piece. The tool is often made of tungsten carbide and rotates at high speed, which produces friction heat. The process forms a bushing in situ and is clean and chipless. This chipless machining process has the advantage of reducing the time required for drilling and incurring less tool wear, thus lengthening the service life of the drill. Also, unlike traditional drilling that uses cutting fluid to reduce the friction and heat generation, friction drilling is a dry process. Friction drilling creates bushing on sheet metal, tubing, or thin walled profiles for joining devices in a simple, efficient way. The bushing created in the process is usually two to three times as thick as the original work piece. This added thickness can be threaded, providing a more solid connection for attachment than attempting to thread the original sheet. Figure 3 shows some applications of friction drilling. Friction drilling, also known as thermal drilling, flow drilling, form drilling, or friction stir drilling, is a nontraditional hole making method. The heat generated from friction between a rotating conical tool and the work piece is used to soften the work material and penetrate a hole. It forms a bushing directly from the sheet metal work piece and is a clean, chipless process. The thickness of the bushing is usually two to three times as thick as the original work piece. This leaves enough surface area for threading. All work-material in the friction drilled hole contributes to form the bushing. It eliminates chip generation and is a clean, chipless hole-forming process. Unlike the traditional drilling operation using cutting fluid to reduce friction and heat generation, friction drilling is a dry process. Occasionally, a small amount of cutting fluid is used to avoid material transfer from the work piece to the tool.

II. EXPERIMENTATION

A sharp point is evaded and a little level surface is given on the cone head to start friction heat, as the cone enters into work the metal gives path because of plastic deformation and the measurement step by step increments. The work material utilized in the current examinations is

ISSN: 2321-3914
Volume:1 Issue: 3
March 2021
Impact Factor: 5.7
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AA 6351. It has an organization C 0.37-0.44, Mn 0.45-0.90, P 0.40 (max), S 0.50(max). Aluminum of this arrangement has wide assortment of utilizations and is most regularly utilized in industry. It is expected that these examinations will be helpful for the ventures. A column drilling machine of Batli-Boi make is retrofitted with uncommon pulleys so as to get the working rate scope of 00-4000 rpm. As the temperature produced is assessed to be in the reach 400-500OC, the device made of rapid steel is chosen for experimentation. The device has funnel shaped portion at the base and a shoulder in the cylindrical area. The test is appeared in figure 1. For the reason for experimentation, two devices are picked, one is with an included angle of 30^{O} and the other is of 60^{O} are appeared in figure 2. The work piece is a 1 mm thick aluminum cold rolled sheet and is mounted on top of Spranktronics model drilling dynamometer for estimating push force and torque during friction drilling measure (figure 3). The friction penetrated work pieces are appeared in figure 4.

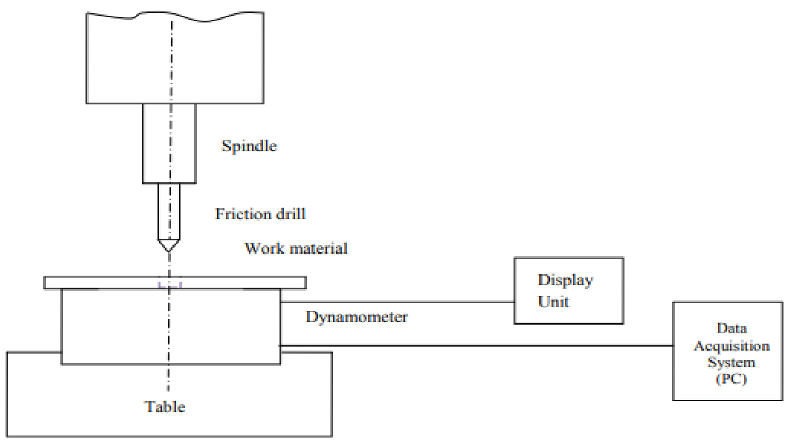

Fig 1: Experimental for a measuring Torque & Thrust

ISSN: 2321-3914
Volume:1 Issue: 3
March 2021
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Subject Engineering

Figure 2: Typical tools of friction drill

Figure3: Drill dynamometer

ISSN: 2321-3914
Volume:1 Issue: 3
March 2021
Impact Factor: 5.7
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Figure4: Work pieces after machining

III. DESIGN OF EXPERIMENTS

Variety of torque and thrust force in the friction drilling measure are examined in the current work. The huge cycle boundaries imagined are speed of hardware, feed rate given to instrument and remembered angle for the cone portion of hardware. Subsequent to having thorough preliminaries, which actuates imperfection free holes the scope of the cycle boundaries is distinguished; the upper and lower cutoff points of the boundaries are portrayed in Table 1. A full factorial (2^3) tests are conceived and are directed aimlessly to kill error. Each trial is rehashed twice for the purpose of consistency. As the plan grid is same to L_8 orthogonal cluster of Taguchi technique, the information have additionally been investigated for commitments and ideal boundaries are recognized. Multiplicative relapse models are considered for the reactions in particular torque and thrust force. The relapse condition is in the form y = K. $N^a .S^b 0. \beta^c$ where y is the selected response, N is speed, S is feed,β is the cone angle and K, a, b and c are constants. There is sharp variety in thrust force and torque during the cycle. Nonetheless, just pinnacle esteems are thought of. Now and again, the work got welded to the apparatus during the withdrawal. Thus, legitimate clipping is given during experimentation.

ISSN: 2321-3914
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Table 1: Selection of levels for process parameters

S. No.	Process parameters	Units	Levels	
			1	2
1	Speed (N)	Rpm	2000	00
2	Feed (S)	mm/rev	0.1	0.3
3	Cone Angle ( )	Angle in degrees	30^{O}	60^{O}

Table 2: Experimental Matrix

Expt. No.	Speed (N)	Feed Rate (S)	Cone angle ( )	Torque (N-m)		Thrust force (N)	
				Trail 1	Trail 2	Trail 1	Trail 2
1	2	2	2	1.1	1.05	532	535
2	2	2	1	1.5	1.30	275	280
3	2	1	2	0.85	0.87	506	510
4	2	1	1	1.62	1.65	253	260
5	1	2	2	0.71	0.73	608	615

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6	1	2	1	2.1	2.15	4	2
7	1	1	2	0.51	0.55	551	540
8	1	1	1	1.82	1.85	356	360

IV. RESULTS AND DISCUSSIONS

The experiments are led indiscriminately and the outcomes are aggregated in Table 2. Subsequent to applying logarithms to the relapse model, the constants are assessed. The last conditions of the reactions are given in Table3. The information has been examined and the investigation of difference (ANOVA) is processed utilizing Yate's algorithm. The commitment of every boundary is additionally assessed and is introduced in Tables 4 and 5.

Table 3: Development of Regression Equation

Response	Regression equation
Thrust force (y_1)	$y_1 = 423N^{-31.6}\ S^{53.0}\ 1009$
Torque (y_2)	$y_2 = 2.9\ N^{-0.07}\ S^{0.61}\ -3.9$

Table 4: ANOVA for Thrust force

Parameter	SS	Dof	Variance	F Ratio	Contribution %
Speed (N)	15977	1	15977	0.102	1.86

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Feed (S)	44944	1	44944	0.284	5.25
Cone Angle ( )	160	1	160	1.03	19.05
Error	63147 4	4	157868		
Total	85539 5	7			

Table 5: ANOVA for torque

Parameter	SS	Dof	Variance	F Ratio	Contribution %
Speed (N)	0.0784	1	0.0784	0.001	0.028
Feed (S)	5.95	1	5.95	0.9	2.16
Cone Angle ( )	243.4	1	243.4	38.6	88.3
Error	25.2	4	6.3		
Total	275.2	7			

It is discovered that the impact of cone angle is high on thrust force and torque as apparent from huge commitments. The variety of torque and thrust force are in a similar pattern with the variety of speed and feed while they 117 show reverse relationship with cone angle (Figure 5). High thrust force isn't attractive since it deforms sheet metal and shortens the life of hardware. The bowed sheets demonstrate high thrust force, and subsequently low speed is wanted for

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powerful drilling. The work piece is entered by the instrument tip focus and is liable for the thrust force; also, it is obvious from change in color of the hole at the region that the warmth age was distinctive at different velocities of the device.

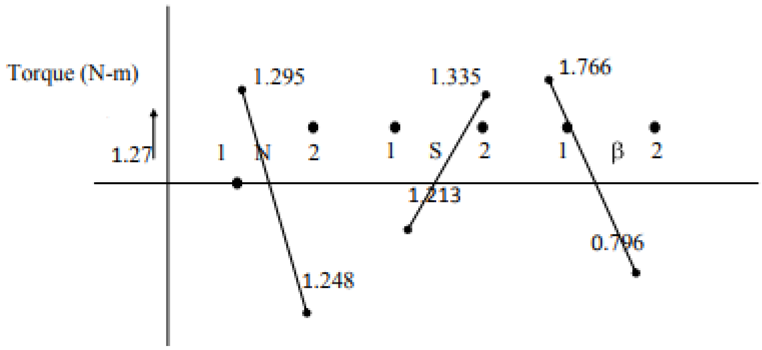

Figure 5(a): variation of Torque in friction drilling

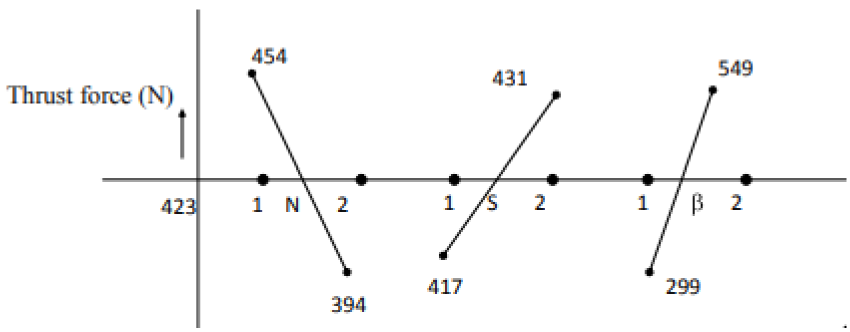

Figure 5 (b): Variation of Thrust force in friction drilling

V. CONCLUSION

After effective fruition of plan and assembling of the friction drill instrument and directing different experiments From the commitment esteems, it is presumed that the cone angle of the device is a basic boundary and is impacting both torque and trust force. This cycle can be utilized as substitute for two stage drilling and counter sinking. An exceptionally polished surface is acquired for AA6351 in friction drilling at low and medium speed, discolorations are gotten at rapid. Friction drilling is a lot of accommodating to the sheet metal works. From the commitment esteems, it is presumed that the cone angle of the apparatus is a basic boundary and is affecting both torque and trust force. This cycle can be utilized as an option for two stage drilling and counter sinking.

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