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Study and Optimization of Transfer Press Machine process Parameters for Carbide Material

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Abstract: ***In some situations, Transfer Press Machine can be an accurate and effective way to make things. The Taguchi Method was used to figure out how the Transfer Press Machine process parameters affected the Tool failure rate of carbide alloy. MINITAB 19 uses parameters like Tip radius, Backing plate length and Riser angle to fine-tune the rate of tool failure. The optimal values of three parameters are determined by using an ANOVA and Taguchi orthogonal array L9 to get the minimum possible brerakage rate.***
Keywords: Transfer Press Machine, Taguchi Method, ANNOVA.

I. INTRODUCTION

A needle roller bearing is a special type of roller bearing which uses long, thin cylindrical rollers resembling needles. Ordinary roller bearings' rollers are only slightly longer than their diameter, but needle bearings typically have rollers that are at least four times longer than their diameter. Like all bearings, they are used to reduce the friction of a rotating surface. Compared to ball bearings and ordinary roller bearings, needle bearings have a greater surface area in contact with the races, so they can support a greater load. They are also thinner, so they require less clearance between the axle and the surrounding structure. Needle bearings are heavily used in automobile components such as rocker arm pivots, pumps, compressors, and transmissions.
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II. EXPERIMENTATION

A. Methodology of Experiment

Based on the present press process followed, some of the problems were identified such as Parameters like Tip radius, Backing plate length and Riser angle etc. play an important role in minimum the Transfer press machine and to improve the tool breakage rate, so as to overcome the existing problem, few optimization technique has to be incorporated. Once the root cause of the problems/parameter which impacted the tool breakage rate was identified and objectives were set to overcome the problem. Tip radius, Backing plate length and Riser angle identified as the main factor affecting the Transfer press machine. Based on the observation.

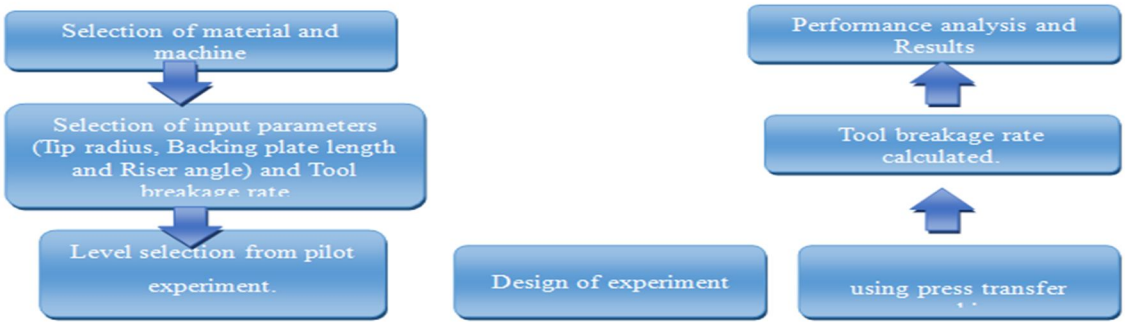

Figure:1 Flow chart of Methodology

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B. Selection of Material Carbide

Advantages of carbide High hardness, Superior strength & toughness, Corrosion resistant and Withstand extreme temperature

Figure:2 Selection of material

Compound	*W*	*Cr*	*V*	*C*	*Co*	*Fe*
Value %	*13.0*	*4.75*	*6.0*	*2.15*	*10.0*	*Rem.*

Table: 1 Chemical Properties

C. Experimental Machine Selection

Figure: 3 Transfer press Machine

III. RESULTS AND DISCUSSION

In general, the signal-to-noise ratio or main effects plot for means is used to learn more about how the input parameters Tip radius, Backing plate length and Riser angle affect the output tool wear rate. For this, the statistical programme Minitab 19 was used. We used analysis of variance (ANOVA) to find the parameters that had the most effect on tool wear rate, and we used linear regression to predict tool wear rate values in the future.

A. Experimental Result

L9 OA tool wear rate measurements are shown in Table 2 for runs 1–9. The signal-to-noise ratio for each of the nine studies is also included. SN ration is used to normaliszed the experimental data in specific range calculated and the response for SN ratio smaller is better selected.

Given below is equation of Signal to noise (S/N) ratio for the response

$$S/N = -10\log_{10}\sum\frac{y2}{n}$$

Where y is the value of response and n is the total number of experiments.

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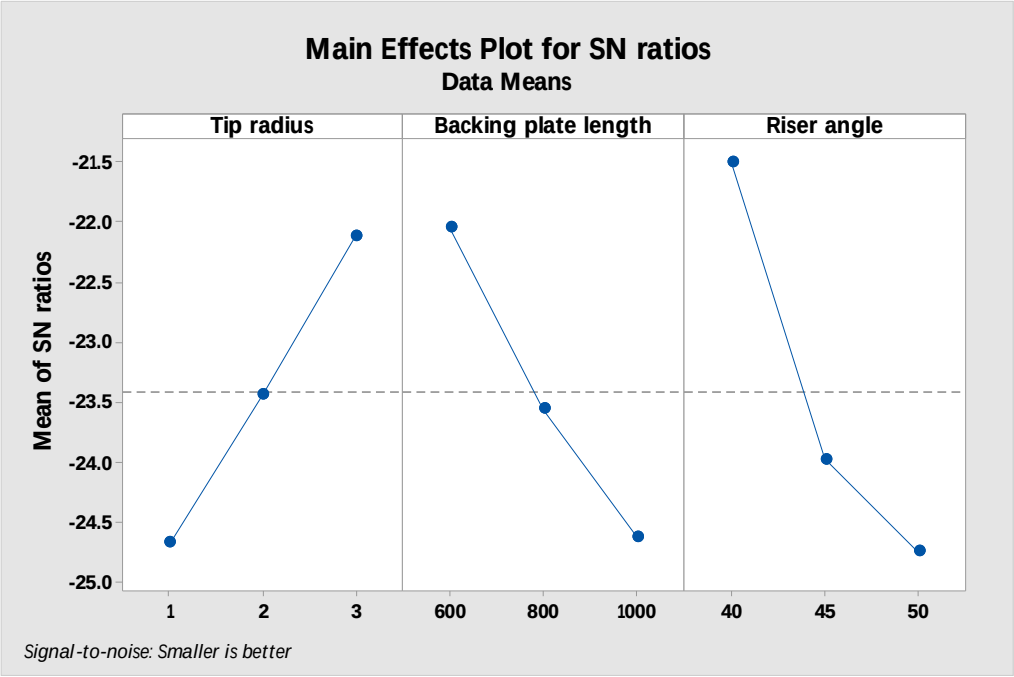
Table 2 L9 orthogonal array with response characteristic.

Experiments	Input Factors			Output Responses	
Trial No.	Tip radius (mm)	Backing plate length (µm)	Riser angle (degree)	Tool Failure rate (Out of 300)	S/N Ratio
1	1	600	40	12	-21.5836
2	1	800	45	19	-25.5751
3	1	1000	50	22	-26.8485
4	2	600	45	13	-22.2789
5	2	800	50	18	-25.1055
6	2	1000	40	14	-22.9226
7	3	600	50	13	-22.2789
8	3	800	40	10	-20.0000
9	3	1000	45	16	-24.0824

Minitab 19 is used to compute the S-N ratio values. The S/N ratio is quite consistent throughout all experiments, showing little to no variance.

B. Main Effects of Tool failure rate



Graph 1 Main Effects Plot for S/N Ratio

The optimal input parameters were tip radius 3mm (level 3), Backing plate length 600µm (level 1) and rise angle 40 degree (level 1). The graph shows the effect of the control factors on carbide material..

C. ANOVA Result

ANOVA, the ratio between the variance of the cutting parameter and the error variance is called Fisher's ratio (F). It is used to determine whether the parameter has a significant effect on the quality characteristic by comparing the F test value of the parameter with the standard F table value at the P significance level. If the F test value is greater than P test the process parameter is considered significant. Relevance of the models is tested by ANOVA.

It is a statistical tool for testing the null hypothesis for planned experiments, in which several different variables are studied simultaneously. ANOVA is used to quickly analyze the variances in the experiment using the Fisher test (F test). ANOVA table shown the result of the ANOVA analysis. ANOVA analysis makes it possible to observe that the value of p is less than 0.05 in the three parametric sources. It is therefore clear that Tip radius, Backing plate length and Riser angle of the material have an influence on the carbide material. The last column of cumulative ANOVA has shown the percentage of each factor in the total variance that indicates the degree of impact on the outcome.

Table 3 ANOVA Result.

Source	DF	Adj SS	Adj MS	F-Value	P-Value	% Contribution
Tip radius	2	0.8845	0.4422	41.33	0.037	27.79
Backing plate length	2	0.8382	0.4191	39.16	0.039	26.03
Riser angle	2	1.4393	0.7196	67.25	0.019	45.21
Residual Error	2	0.0214	0.0107			
Total	8	3.1834				

Ton (38.39%), Toff (28.67%), and Ip (28.31%) all have significant bearing on the SR. Ton's biggest contribution (38.39%) makes it the most important of the three, whereas Ip has the smallest impact.

D. Development of Regression Model for Tool failure rate

Regression model has been developed using Minitab 19 software. Substituting the experimental values of the parameters in regression equation, values for tool failure rate have been predicted for all levels of study parameters. Graphical representation also shows that a predicted and experimental value of tool failure rate correlates with each other

Regression Equation –

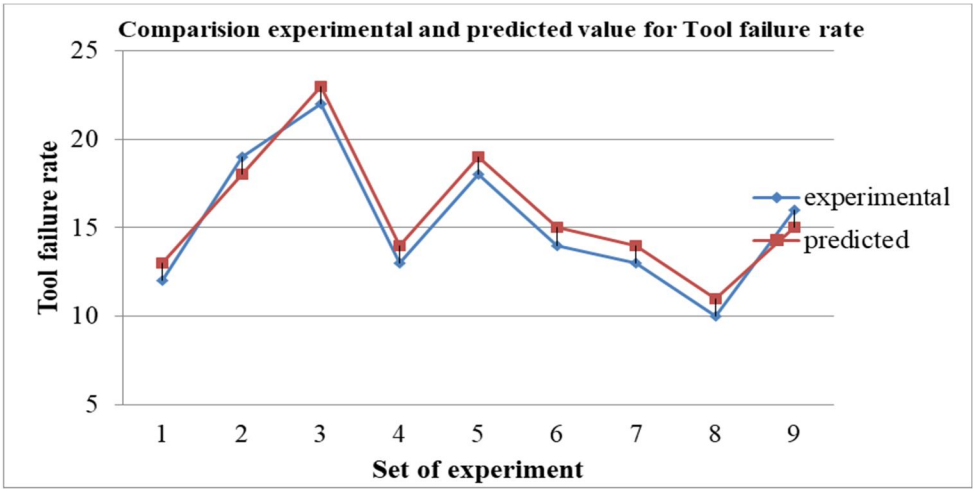
Tool failure rate = -14.94 - 2.333 Tip radius + 0.01167 Backing plate length + 0.5667 Riser angle

Table 4 gives comparison between experimentally measured and predicted tool failure rate by developed mathematical equation.

Table 4 Experimental and Predicted Values of tool failure rate

Sr. No.	Experimental value	Predicted value	Error %
1	12	13	7.69
2	19	18	5.55
3	22	23	4.34
4	13	14	7.14
5	18	19	5.26
6	14	15	6.66
7	13	14	7.14
8	10	11	9.09
9	16	15	6.66

There was less than a 10% discrepancy between the tool failure rate values derived from the regression equation and the experimental results for each encounter. It follows that the constructed regression equation is reliable.



Graph 2: Comparison between experimental and predicted value of Tool failure rate

Taguchi design and ANOVA gives mathematical model which predict the result nearly accurate. This can be due to this project deals the parameter level in very short range. Also every effort has done to maintain noise factors constant to greater level throughout experimentation tool failre decreases for first sample and increases for ninth sample because of experiment from 1-9 are the set of experiments from Taguchi design L9 array; every experiment has different level of parameters and having unique combination of parameter level. The comparison between experimental and predicted value of tool failure rate is as shown in graph 2.

E. Confirmation Experiment Result

Experiments was conducted for tip radius at level 3, Backing plate length at level 1 and rise angle at level 1
Tip radius 3mm (level 3), Backing plate length 600µm (level 1) and rise angle 40 degree (level 1).

Table 5 Confirmation experiment result for Tool failure rate

Parameter	Model value	Experimental value	Error %
Tool failure rate (No's)	8	9	9.21

Confirmation experiment is conducted by keeping parameters at optimum levels suggested by Taguchi method and the tool failure rate value obtained has been compared with value predicted by the regression model keeping the parameters at same levels. It can be seen that the difference between experimental result and the predicted result is 9.21%. This indicates that the experimental value correlates to the estimated value.

IV. CONCLUSIONS

This study covers the observations about the tool failure rate over the Carbide material by the process of Transfer press Machine for the different input parameters to thoroughly study over the effect of Laser beam machining process on the Carbide material. Throughout the experimentation I got some results as under.

The combination of laser cutting parameters i.e. Tip radius, Backing plate length and Riser angle were planned by L9 Orthogonal Array Taguchi method , based on the results obtained and derived analysis the following can be concluded.

1) The optimal solution obtained for Tool failure rate based on the combination of press machine cutting parameters and their levels is (i.e. Tip radius 3mm, Backing plate length 600, and Riser angle 40 degree).
2) ANOVA results indicate that Riser angle plays prominent role in determining tool wear rate. The contribution of Tip radius, Backing plate length and Riser angle to the quality characteristics Tool failure rate is 27.21%, 26.03% and 45.21% respectively.
3) Riser angle and Tip radius are the most significant parameters majorly affecting the tool failure rate whereas the Backing plate length is much smaller.

4) The optimal cutting parameters are determined using Taguchi methods match with the experimental values by minimum errors i.e 9.21% .

5) Through the developed mathematical models, any experimental results of the tool failure rate with any combination of press cutting parameters can be estimated.

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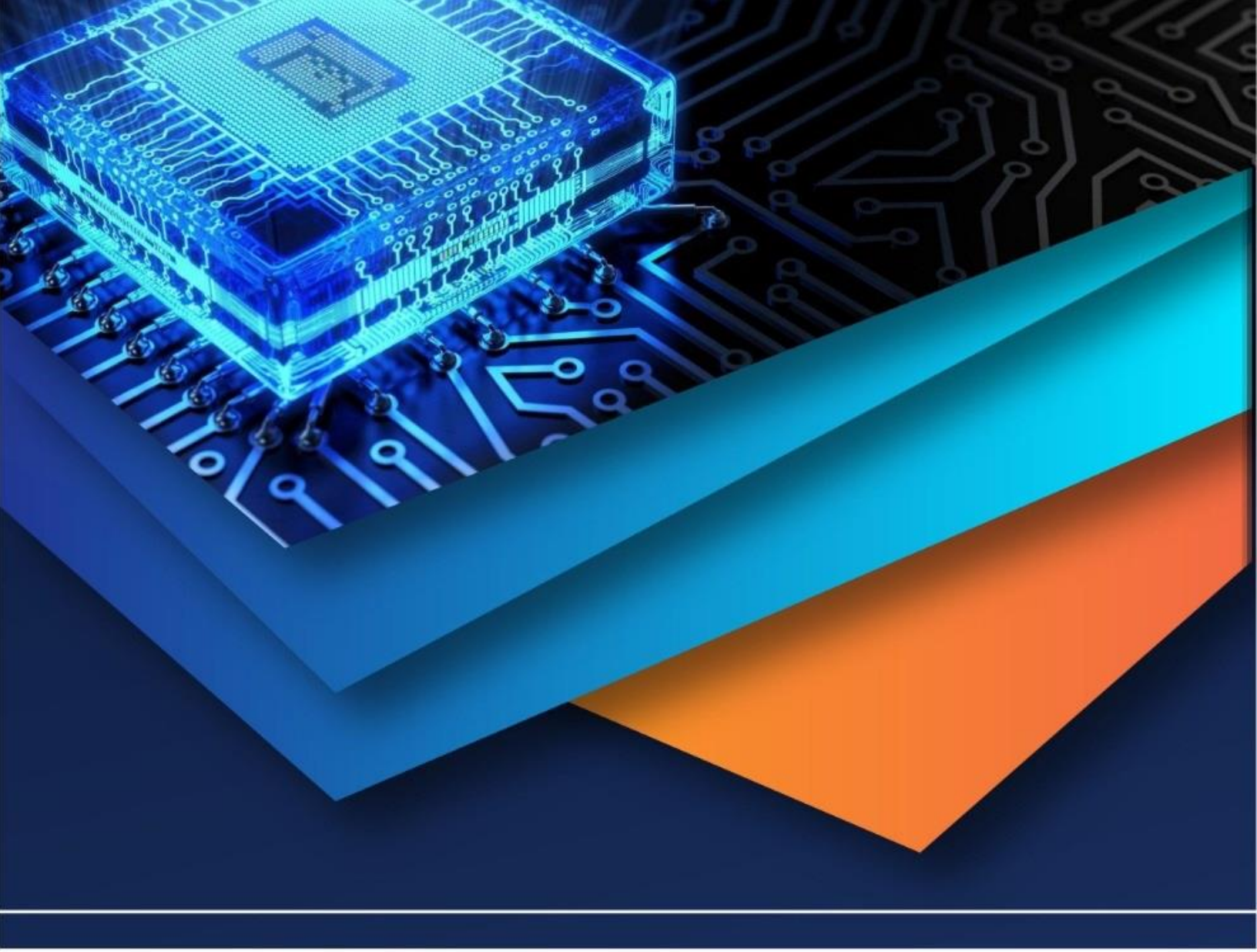

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