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Research Paper

NUMERICAL SIMULATION AND OPTIMIZATION OF COLD ROLLING PROCESS PARAMETERS FOR STRAIN

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In the present work the process parameters used in the cold rolling mill were influenced. In the present study the method design of experiment is used for finding some quality output for the sake of the cold rolling mill and which effects then quality of the cold rolling sheet and the cold rolling mills parameters. There are three factors and their three levels are decided for finding quality outputs for this process response surface method is used and 20 experiments were created by the Minitab software. Finally, all the 20 experiments were run in the simulation software ansys for finding the value of the strain. After finding the value of the strain Anova analysis is performed and best results are collected as a quality output.

Keywords: Cold rolling mill, ANSYS, ANOVA, DOE

INTRODUCTION

The cold rolling is the process in which the sheet is passing through the two successive pair of the roll for the gauge conversion. The process of the cold rolling mill is carried out above the recrystallization temperature where the crystal structure of the sheet is got changed, and the mechanical properties of the sheet is also get changed. There are different types of cold rolling mill such as 2 high, 4 high, 6 high, 12 high, the difference of the quantity of the work and the backup roll. In the 2 high mills there is one work and the one back up roll, and in the 4 high mil there is 2 work and the 2 backup roll. The change in the deformation of the sheet is depended upon the various input and the output parameters such as entry and exit tension, thickness of the sheet, width of the sheet, gauge conversation, no passes selected for the gauge conversation.

LITERATURE REVIEW

1. Alsamhan *et al.,* studied that the in sheet metal forming the process of cold roll forming is very much important, however design procedure of the product as in terms of pass schedule of rolling mill is an art of production engineer more than science. Hence to reduce the cost and time finite element model is developed and

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analysis for prediction of total deformation and the final geometry of the product.

2. Zhi Wu Han *et al.,* studied that cold roll mill forming is an important process of sheet metal forming process, through which various product of sheet such as plain sheet, strip, pipes are made because of rolling mill through the rolls rotating in the mill. On the basis of updated lagrange method for the various sheet metal deformation mechanism, an method presented for large elastic and plastic deformation.
3. Barbara Rossi *et al.,* studied that the mechanical properties such as strain hardening is modified through the process of the cold roll forming process, and for understanding the phenomenon which is best suited for tradition construction steel profile which is mandatory for the resistance of the member, lack of information may lead to the non-linearity of the material and in stress strain curve in high strength steel and stainless steel.
4. Bui *et al.,* studied the process of FEM subjected to the cold rolling mill forming process, the numerical result comes from the simulation are compared with the experimental result available in the various literature. And after the experiment performed the result are the value of the yield strength and the value of the work hardening coefficient having significant impact on the product quality whereas the speed of the forming process which is the speed of the roller in the rolling and the amount of the friction produced between the sheet and the roller of the rolling mill having less impact on the quality of the product and doesn't play any major role. In this experiment the simulation which has performed is the full 3D model whereas in many of the simulation process there are 2D as well as 3D model are present.

METHODOLOGY

In the present study the design of experiment methodology is used for finding some quality outputs, initially three factors and three levels are selected for the crating the experiment , three factors such as thickness, velocity and the hardening exponent were selected for the study, finally, all the experiments were run in the simulation software Ansys explicit dynamics for finding the value of the strain for all the 20 experiments. After calculating results from the analysis Anova analysis is performed for the current study and in the anova analysis all the responsible factors for which are affecting the quality of the output parameters are discussed in Table 2, the Anova analysis is performed for the current study confining response as strain, from the above table it is predicted that only the thickness is having the value of the P below 0.05%, it means thickness is the only parameters responsible for finding the value of the strain. Or the value of the strain is only get deflected by changing in the value of the thickness.

RESIDUAL PLOT FOR STRAIN

In the above Figure residual plot for strain is shown, in the very first graph the normal probability graph is shown in which all the data are normally plotted on the normal probability line, it means

Table 1 : Design of Experiment

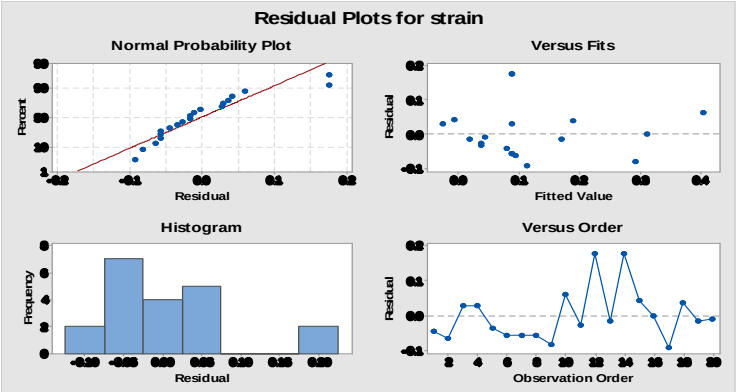
S. No.	Thickness	Hardening Exponent	Velocity	Strain
1.	3.5	0.46	2083	0.035200
2.	3.5	0.36	2083	0.031100
3.	3,5	0.41	2083	0.118200
4.	2.5	0.36	1666	0.002597
5.	2.5	0.46	1666	0.002770
6.	3.5	0.41	2083	0.032456
7.	3.5	0.41	2083	0.032456
8.	3.5	0.41	2083	0.032456
9.	4.5	0.41	2083	0.212960
10.	4.5	0.36	2500	0.465770
11.	2.5	0.41	2083	0.011007
12.	3.5	0.41	2083	0.265310
13.	3.5	0.41	1666	0.003559
14.	3.5	0.41	2083	0.265310
15.	2.5	0.46	2500	0.036211
16.	4.5	0.46	2500	0.310380
17.	3.5	0.41	2500	0.022200
18.	4.5	0.46	1666	0.227600
19.	4.5	0.36	1666	0.155320
20.	2.5	0.36	2500	0.034651

Table 2: Anova Analysis

Source	Adj MS	F-Value	P-Value
Model	0.025576	2.47	0.088
Linear	0.062818	6.06	0.013
Thickness	0.165070	15.92	0.003
Hardening exponent	0.000597	0.06	0.815
Velocity	0.022788	2.20	0.169

the data along the normal probability line are the data which are well fitted for the observation, and the data which are deflected from the normal probability line are the data which have no impact on the output they are not responsible for the quality outputs. The second graph shows the

Figure 1: Residual Plot for Strain



verses fit in which there is graph between the residual and the fitted value is shown. In the third graph of the histogram it is clear that maximum data are falls on the zero, 0.05, etc. it means the minimum distance between the normal probability line and the residual, maximum data falls.

CONCLUSION

In the present study numerical simulation is done for the cold rolling process parameters for finding the quality output upon which the quality of the cold rolling sheets depends. Firstly, all the values of the strain is calculated from the Ansys Explicit dynamics, and then Anova analysis is performed, now in the Anova analysis it is concluded that thickness is the only parameters having the value below than 0.05, and having the confidence interval of the 95%, it means the thickness is the parameters by virtue of which the quality of the cold rolled sheet is deflected in the present study, or by changing the value of the thickness, it might be possible that the quality of the sheet decreases or might increases.

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