SYNOPSIS

Friction drilling process which is most efficient and economical way of producing the holes in the sheet material has been experimentally investigated in this work. It is an attempt to improve the quality and reliability of the friction drilling process by proper selection and optimization of process parameters. The friction drilling process is carried out with the standard geometry friction drilling tools which are commercially available. The material selected for this research is AISI 1015 steel which is commonly available and is used in many applications. The experiments are carried out using the Taguchi method and data is collected. The data analysis has been carried out using the statistical tools viz. Taguchi method, ANOVA and Regression. The multi attribute decision making in the friction drilling process has been attempted with the AHP and TOPSIS methods. The modeling of the process which is capable to monitor the process intelligently is carried out using the Artificial Neural Network (ANN). The characterization of the process has been done by considering some important aspects of the friction drilled holes like Bush Length, Bush hardness, Heat Affected Zone, Maximum Temperature during friction drilling. The Grey Analysis has been implemented to find out the optimal condition considering all these aspects simultaneously. The separate experiments are conducted in order to study the threading process on the friction drilled holes. The comparative assessment of the form threading process and thread cutting process is carried out for threading the friction drilled holes. The Relative Reliability Risk Index ($R^3I$) has been used to find out the relative worth of the responses in the thread tapping process. The organization of this report is as follows:

Chapter 1 is the basic introduction of the Friction Drilling Process. The attempt has been made to focus some light on theoretical aspects of the friction drilling process. Here the Force modeling, Thermal Modeling and Tool Wear modeling have been explained briefly. Also this chapter includes aims and objectives of study.

Chapter 2 discusses the work carried out by previous researchers. Rigorous literature reviews related to Friction Drilling Process, Friction Stir Welding Process, Optimization Techniques, Artificial Neural Network (ANN) based pattern recognition system have been discussed. The inferences drawn from literature review formed the base for defining the problem and setting the objectives of the research.
Chapter 3 outlines the experimental details for the friction drilling process. It provides the information regarding factors and their levels selection, design of experiments with Taguchi’s L_{27} orthogonal array, and method of data collection and measurement.

Chapter 4 gives the detailed data analysis using analysis of variance (ANOVA) and Taguchi methods. Also this chapter explains the use of regression analysis for development of mathematical models between the response variables and influencing variables.

Chapter 5 deals with the multi attribute decision making of Friction Drilling Process using an AHP (Analytical Hierarchy Process) and TOPSIS (Technique for Order Preference by Similarly to an Ideal Solution) method. The selection of the optimum setting conditions for the multi-response friction drilling process has been discussed here.

Chapter 6 explains the development of the Artificial Neural Network (ANN) modeling for the friction drilling process. The work also focuses on the comparative performances of the models developed by the ANN and Regression.

Chapters 7 in this chapter the characterization of the friction drilling process have been attempted. It explains the measurement and analysis of the parameters such as maximum temperature during the process, bush length, hardness, HAZ and microstructure of the friction drilled holes. This chapter also explains the application of Grey analysis for optimization of the response variables.

Chapter 8 carries out the comparative assessment and analysis of the form threading tool and cut tapping tool on the friction drilled holes by Taguchi method and ANOVA. In this chapter also the Relative Reliability Risk Index (R^3I) has been used to find out the relative worth of the responses in the thread tapping process.

Chapter 9 includes the conclusions drawn from the research. It also presents the future scope.

Lastly the reference section provides the information regarding the referred research papers, journals and books in the area of friction drilling and manufacturing engineering.

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