EFFECT OF WELDING PARAMETERS ON MECHANICAL PROPERTIES OF FRICTION STIR WELDED ALUMINIUM ALLOY 1100

DISSERTATION

Submitted in partial fulfilment of the requirement

for the award of the degree of

MASTER OF TECHNOLOGY

in

PRODUCTION ENGINEERING

Submitted By

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2014

DECLARATION

I, **S. Deivanai** , hereby declare that the project work, which is being presented in this dissertation entitled "**Effect of welding parameters on Mechanical properties of Friction stir welded Aluminium Alloy 1100** in the partial fulfilment for the award of degree of Master of Technology in Production Engineering, is an authentic work carried out by me at Delhi Technological University under the guidance of **Dr.Reeta Wattal** ,Professor and **Mrs. Sushila Rani** Asst. Professor of Mechanical ,Production & Industrial and Automobile Engineering Department.

I have not submitted the work in this dissertation for the award of any other degree or diploma to any other university.

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CERTIFICATE

This is to certify that the report entitled " **Effect of welding parameters on mechanical properties of friction stir welded aluminium alloy 1100** " submitted by **S.Deivanai Roll No. 2K11/PIE/25** in partial fulfilment for the award of Master of Technology in Production engineering from Delhi Technological University , is a record of bonafide project work carried out by her under our supervision and guidance.

To the best of our knowledge, the result contained in this thesis have not been submitted in Part or full to any other university for the award of any degree or diploma.

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ACKNOWLEDGEMENT

I would like to express my sincere gratitude to my respected guides Dr . Reeta Wattal , Professor and Mrs.Sushila Rani , Assistant Professor of Department of Mechanical, Production& Industrial and Automobile Engineering, Delhi Technological University, for their confidence shown in me and in giving me an opportunity to work on a new idea, learn and explore under their able guidance.

The pragmatic and invaluable advice of my guides kept me going through the critical phases of the project. I am indebted to them for the insightful and encouraging words that have been the driving force of my project. They provided me with a lot of information and ideas regarding the project. Their sincere guidance and industrious attitude seeped in for inspiring me to reach beyond limits.

I am grateful to Prof.Naveen Kumar, Head, Mechanical, Production& Industrial and Automobile Engineering Department for providing facilities to carry out the investigations.

I also would like to thank Mr. Jagannathan ,superintendent, Mr. Pradeep , senior mechanic and Mr Sunil , Jr. Mechanic of central workshop of mechanical engg department ,DTU for their support during welding of metals.

I also would like to thank my family members , colleagues and my friend Ms. Surabhi lata for their moral support in completing this project.

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ABSTRACT

Friction Stir Welding is considered to be the most remarkable and potentially useful welding technique for several materials, such as Al-alloys, Mg-alloys, brasses, Ti-alloys, and steels. However, during FSW process using inappropriate welding parameters can cause defects in the joint and deteriorate the mechanical properties of the FSW joints. Effect of process parameters :tool rotational speed , weld speed , shoulder pin diameter, on the weld process is determined by co – relating the process parameters with mechanical properties such as tensile strength ,hardness at weld nugget , hardness at thermo mechanically affected zone, temperature at weld nugget and temperature at thermo mechanically affected zone.

The design matrix was prepared on the basis of 3 factors , 2 levels , full factorial design. Response surface methodology was used to develop the mathematical models co relating the process parameters with the mechanical properties. The models once developed were checked for adequacy using ANOVA technique. From the adequate models the significant terms were selected using p test. The finally proposed models contains only the significant terms. Main and interaction effects of the process variables on the mechanical properties are presented in graphical form . the developed models can be used for prediction of important mechanical properties and control the weld quality by selecting appropriate process parameter values.

Use of artificial neural network for modelling of the friction stir welding process was done. Artificial Neural Network architecture , using back propagation algorithm was developed which provided satisfactory outputs. Comparison of the performance of the RSM Models and the ANN Model was also done and it was concluded that the when number of factors are less , RSM yields more satisfactory results.

This thesis is divided into 8 chapters. The first chapter discusses the objective and motivation of the problem , followed by the statement of the problem and lastly the plan of investigation , which was undertaken to achieve the objectives. The next chapter gives an insight regarding the research work which has been carried out in related fields such as ANN Modelling RSM application to welding problems , metallurgical investigations etc., chapter 3 gives a brief introduction to the concepts of FSW , ANN , RSM and weld metallurgy followed by the experimental procedures undertaken to carry out the project work . chapter 4 discusses the development of mathematical models . it is followed by chapter 5 where in discussions of the effects

of the process variables on mechanical properties are done . chapter 6 is dedicated to use of ANN for modelling of the FSW process . A comparison of the 2 modelling approaches is also done. Chapter 7 discusses metallurgical effects after welding. Chapter 8 discusses results and conclusions drawn from this study .

KEYWORDS

Friction Stir Welding ,Full Factorial Design , Response Surface Methodology , Artificial Neural Network , Weld Metallurgy , Hardness At Nugget , Thermo Mechanically Affected Zone, Tensile Strength , Microstructure , Thermal Flow

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF SYMBOLS

SYMBOL	REPRESENTS	UNITS
N	Tool Rotational Speed	RPM
W	Weld Speed	MM/MIN
D	Diameter of Pin	MM
TS	Tensile Strength	MPA
H_N	Hardness at weld nugget	HV
H_{HAZ}	Hardness at heat Affected Zone	HV
T_N	Temperature at weld nugget	^0C
T_{HAZ}	Temperature at HAZ	^0C

ABBREVIATIONS

RSM	Response Surface Methodology
ANN	Artificial Neural Network
TMAZ	Thermo Mechanically Affected Zone
HAZ	Heat affected Zone