A

Project Report on

STUDY, ANALYSIS AND OPTIMIZATION OF MIG WELDING PROCESS PARAMETERS FOR MINIMIZATION OF HEAT AFFECTED ZONE (HAZ)

in partial fulfillment for the award of the degree of

BACHELOR OF ENGINEERING

in

MECHANICAL ENGINEERING

Submitted by

Abhijit Borah **(M-08/14)**

Anshuman Sarma **(M-52/14)**

Bhargav Borah **(M-54/14)**

Gaurav Jyoti Gogoi **(M-57/14)**

Prandeep Goswami **(M-87/14)**

Under the Guidance of

Mr. Diganta Kalita

Assistant Professor

Department of Mechanical Engineering

JORHAT ENGINEERING COLLEGE,JORHAT

DIBRUGARH UNIVERSITY::DIBRUGARH

2018

CANDIDATES' DECLARATION

We hereby declare that the work which is being presented in this report entitled "STUDY, ANALYSIS AND OPTIMIZATION OF MIG WELDING PROCESS PARAMETERS FOR MINIMIZATION OF HEAT EFFECTED ZONE (HAZ)" is an authentic record of our own work carried out during the period from August, 2017 to May 2018 under the supervision of Mr. Diganta Kalita, Assistant Professor, Department Of Mechanical Engineering, Jorhat Engineering College, Jorhat, Assam.

The matter presented in this report has not been submitted for the award of any degree of this or any other university.

_____	_____
Abhijit Borah (M-08/14)	Gaurav Jyoti Gogoi (M-57/14)
_____	_____
Anshuman Sarma (M-52/14)	Prandeep Goswami (M-87/14)
_____	
Bhargav Borah (M-54/14)	

This is certified that the above statement made by the candidates is correct to the best of my knowledge.

_____

Diganta Kalita

Assistant Professor

The viva-voce examination of the above candidates of 8th semester B.E. (Mechanical Engineering) on their project has been held on ……. and found satisfactory.

_____	_____	_____
Supervisor	H.O.D	External Examiner

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Abhijit Borah(M-08/14)

Anshuman Sarma (M-52/14)

Bhargav Borah(M-54/14)

Gaurav Jyoti Gogoi (M-57/14)

Prandeep Goswami (M-87/14)

ABSTRACT

The MIG welding process parameters are the most important factors affecting the quality, productivity and cost of welding. As there is a great influence of input welding parameters on the behavior of the Heat Affected Zone (HAZ) during welding, this project aims at the optimization of welding process parameters and also to study the microstructure of the heat affected zone (HAZ) of the welded joint during Metal Inert Gas (MIG) welding. GMAW (Gas Metal Arc Welding) is one of the most widely used fusion welding process having wide applications in industry. It was developed during the early 1940's and technology was taken from the TIG welding process that was already around at the time. MIG (Metal Inert Gas) welding, also known as MAG (Metal Active Gas) and in the USA as GMAW is a welding process that is now widely used for welding a variety of materials, ferrous and non-ferrous. MIG (Metal Inert Gas) welding is most widely used for long continuous welds & versatility in nature as spot welds can also be performed by it. The controllable process parameters normally viz. current, voltage and gas flow inherent to machine play a very significant role in determining the quality and mechanical properties of a welded joint. So, proper selection of process parameters is necessary to obtain weld joint properties viz. surface hardness, tensile strength, penetration, etc.

In this research work, the objective is to investigate the effect of three process parameters welding current, voltage and shielding gas flow rate on one important mechanical property, hardness of the welded joints. An approach of the One-factor-At-A-Time experiment is used for finding out the appropriate range of the levels of the factors. In this approach, all the factor is set at a baseline (or starting point) of levels of each factor. One factor is varied accordingly over its range keeping the other factors at constant. After the completion of experiment, a series of graphs are plotted to find the optimal setting of factors.

The levels of the factors are selected from this optimal setting of factors. An experiment has been designed using Taguchi's Orthogonal Array L9, taking welding current, voltage and shielding gas flow rate as factors having three levels each. The selected levels for welding current are 170 A, 190 A, 210 A and for voltage are 22 V, 24 V, 26 V and for shielding gas flow rate(CO_2) are 14 lit/min, 16 lit/min, 18 lit/min.

The optimal set of process parameters for optimal response surface hardness (476.17 N/mm^2) found to be are: 200 A welding current, 30 V welding voltage and 12 lit/min. gas flow rate. The welding current and welding voltage are found to be significant whereas gas flow rate is insignificant in determining surface hardness.

The optimal values of individual characteristics has been confirmed by actually welded joints using the optimal levels of process parameters and then comparing the predicted values of quality characteristics with the actual ones. It was found that there was no significant difference between the predicted and actual values of quality characteristics. A study is also made on the microstructure of the parent material and the welded joints to have an idea of the change in grain structure. It is observed that the change in the grain structure of the welded joint from that of the parent material is least for the test piece at the optimized levels of the factors..

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NOMENCLATURE

A*B	Interaction of factor A and B
ANOVA	Analysis of Variance
CF	Correction Factor
DOE	Design of Experiment
E3.	Error
Exp	Experiment
F	Degree of Freedom
F	Variance Ratio
F_a	The tabulated F ratio at a confidence level of (1- α)
HB	Higher the Best
L	Number of a level of a Factor
LB	Lower the Better
L_N	Number of level of a factor
MIG	Metal Inert Gas
N	Total number of Results
NB	Nominal the Best
OFAT	One-Factor-At-a-Time
S	Sum of square
S/N Ratio	Signal of Noise Ratio
V	Variance
Y	Results measured in terms of quality characteristics