Element Transfer Behaviour of Recycled Slag in Submerged Arc Welding

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In partial fulfillment of the requirement of the degree of
MASTERS OF TECHNOLOGY in
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DECLARATION

I, Deepanjali Nimker, hereby certify that the work which is being presented in the thesis entitled **"Element Transfer Behaviour of Recycled Slag in Submerged Arc Welding "** in the partial fulfillment of requirement for the award of degree of MASTER OF TECHNOLOGY submitted in the Department of Mechanical Engineering at DELHI TECHNOLOGICAL UNIVERSITY, DELHI, is an authentic record of my own work carried out under the supervision of **Dr. (Mrs.) Reeta Wattal,** Professor, Department of Mechanical engineering. The matter presented in this thesis has not been submitted in any other University / Institute for the award of any degree. This thesis does not contain any plagiarized content . All the references undertaken are mentioned at the end of the thesis.

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CERTIFICATE

This is to certify that the report entitled **"Element Transfer Behaviour of Recycled Slag in Submerged Arc Welding"** submitted by **Deepanjali Nimker** (Roll no. 16/PRD/2010) is the requirement of the partial fulfilment for the award of Degree of Masters of Technology in Production Engineering at Delhi Technological University. This work was completed under my supervision and guidance.

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ABSTRACT

Submerged Arc Welding is a versatile metal joining process in industry. It is the most economical process these days since it involves the concept of “Zero Waste” or “Waste to Wealth”. In this present work, an attempt has been made to analyse the effect of Welding parameters on C, Mn, Si, S and P content of the weld metal by using recycled slag. Slag has been recycled by mixing various percentage of crushed slag with fresh flux. Using this slag flux mixture, the weld metal chemistry of the given welded specimens were evaluated and compared. As a result it was found that slag flux mixture upto 75% slag is within the acceptable range of AWS (American Welding Society) specifications.

The design matrix was formulated on the basis of Half Factorial design. Welding Current, Arc Voltage and Travel Speed were selected as three independently controllable process parameters. Welding was carried out on mild steel plate to obtain bead on plate welds. The coefficients of models were determined by Regression Analysis. The adequacy and the significance of the model was tested by ANOVA technique followed by ‘F’ test and ‘t’ test respectively. Using this model, main and interaction effects of the process parameters on responses – C, Mn, Si, S and P were determined quantitatively and presented graphically. As a result ,it has been found that the transfer of the elements have predominant effect on the welded specimen even when the process involves the use of reclaimed slag .Therefore, it is necessary to compute and understand the effect of various factors which controls the weld metal chemistry.

Keywords: Submerged arc welding, Half Factorial Design, Regression Analysis, ANOVA

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LIST OF SYMBOLS

Symbol	Represents	units
C	Carbon	%
M	Manganese	%
Si	Silicon	%
S	Sulphur	%
P	Phosphorus	%
A	Current	Ampere
V	Arc Voltage	Volts
S	Travel Speed	mm/min

ABBREVIATION

AC	Alternating Current
ANOVA	Analysis of Variance
AWS	American Welding Society
DC	Direct Current
HAZ	Heat Affected Zone
OCV	Open Circuit Voltage
SAW	Submerged Arc Welding
SMAW	Shielded Metal Arc Welding