

Contents

Acknowledgement	iv
Abstract	vi
Abbreviation	viii
List of Figure.....	xii
List of Table	xvi
CHAPTER 01 Introduction.....	1
1.1 Preamble.....	1
1.2 Background	1
1.3 Activated Tungsten inert gas (TIG) welding process.....	3
1.4 Variants of Activated Tungsten Inert Gas (A-TIG) welding process	4
1.4.1 Flux Bounded TIG welding	5
1.4.2 Flux Zone TIG welding	5
1.5 Motivation of research	6
1.6 Objectives.....	7
1.7 Methodology	7
1.8 Thesis outline	8
Chapter 02 Literature survey	10
2.1 Preamble.....	10
2.2 Activated TIG welding mechanisms	10
2.3 Forces acting in activated TIG welding	14
2.2.1 Marangoni forces.....	14
2.2.2 Lorentz force.....	15
2.2.3 Buoyancy force.....	16
2.2.4 Aerodynamic drag force	16
2.4 Consequence of process parameters on weld bead geometry of stainless steel TIG and activated TIG weld	17
2.4.1 Welding current	17
2.4.2 Weld travel speed	18
2.4.3 Arc voltage	20
2.4.4 Arc length	21
2.4.5 Welding electrode geometry.....	22
2.4.6 Shielding gas.....	23
2.4.7 Activating flux	24
2.5 Optimization of stainless steel A-TIG weld process parameters	29
2.6 Consequence of process parameters on microstructure and mechanical properties of TIG	

and A-TIG stainless steel weld.....	31
2.6.1 Austenitic stainless steel weld	31
2.6.2 Ferritic/martensitic stainless steel weld	34
2.6.3 Duplex stainless steel weld.....	36
2.6 Recent developments in the A- TIG welding process	37
2.7 Summary of Literature Survey	38
CHAPTER 03 Experimental setup and procedure.....	40
3.1 Preamble.....	40
3.2 Development of welding fixture	40
3.3 Selection of material and fluxes	41
3.3.1 Flux selection for A-TIG and FB-TIG welding.....	44
3.3.2 Flux selection in FZ-TIG welding	46
3.4 Metallurgical and Mechanical examination	46
3.4.1 Metallurgical examination.....	47
3.4.2 Tensile testing methodology.....	47
3.4.3 Microhardness methodology	48
3.4.4 Impact testing methodology	48
3.5 Layout of Experiments	49
CHAPTER 04 Experimentation of A-TIG welding.....	51
4.1 Preamble.....	51
4.2 A-TIG welding trial experiments	51
4.2 Experimentation of A-TIG Welding	55
4.3 Investigation of Metallurgical and Mechanical property	57
4.3.1 Weld bead characteristics	57
4.2.2 Microstructure	59
4.2.3 Tensile strength.....	60
4.3.3 Microhardness	62
4.4 Development of mathematical model	63
4.4.1 Development of a mathematical model for depth of penetration	63
4.4.2 Development of a mathematical model for bead width.....	65
4.4.3 Development of a mathematical model for tensile strength	67
4.4.4 Development of a mathematical model for Micro hardness.....	69
4.5 Effect of process variables on responses.....	70
4.6 Desirability approach in RSM.....	75
4.7 Optimization and validation of optimum parameters.....	76
4.8 Summary	79
CHAPTER 05 Experimental study of FB-TIG welding	81

5.1 Preamble.....	81
5.2 Purpose of adopting Flux Bounded TIG (FB-TIG) welding.....	81
5.3 Experimentation of FB-TIG weld	82
5.4 Influence of flux gap and flux on weld bead geometry.....	83
5.5 Influence of heat input (welding current) on weld bead geometry and microstructure .	86
5.6 Effect of heat input on mechanical properties.....	89
5.6.1 Tensile strength.....	89
5.6.2 Microhardness	90
5.7 Summary	91
CHAPTER 06 Experimental study of FZ-TIG welding	93
6.1 Preamble.....	93
6.2 Purpose of adopting Flux Zone TIG (FZ-TIG) welding	93
6.3 FZ-TIG welding trial experiments	94
6.3.1 Effect of flux on weld bead geometry	95
6.4 Comparison of A-TIG, FB-TIG and FZ -TIG weld joint.....	98
6.4.1 Weld bead geometry	98
6.4.2 Mechanical properties.....	101
6.4.3 Assessment of Electrode tip	103
6.4.4 Weld bead Aesthetic appearance	104
6.5 Summary	105
CHAPTER 07 Conclusion and Future scope.....	107
7.1 Introduction	107
7.2 Conclusions	107
7.3 Future Scope.....	109
References.....	110
List of Publications	122