Table	Title	page
1.1	Year of occurrence of API grade pipeline steel (Trench et al, 2001)	2
1.2	Mechanical properties of various pipeline grade steels (Specification for linepipe steel, 2008)	2
2.1	Flux behaviour related with physicochemical properties [Singh et al, 2013, Olson et al, 1979]	7
2.2	Effect of Ti, Al, Mn, Zr and V on microstructure Carbon-Manganese-Columbium deposits [North et al., (1979)]	13
2.3	Impact of micro-alloying components on hardness, microstructure and notch toughness of pipeline weld [Y. Yoshino et al., (1979)]	13
2.4	Cracks formation observed during submerged arc welds at high temperature [Allen et al, 1992]	16
4.1	Significance of regression using ANOVA	23
4.2	Qualitative observations for basic flux system (using flux no.1)	25
4.3	Elemental chemical analysis of mineral components	29
4.4	Design matrix for basic flux formulation	30
4.5	Design matrix for rutile-basic flux formulation	30-31
4.6	Design matrix for rutile-acidic flux formulation	31
4.7	Previous references shows the surface tension factor (f_t) for different oxides	33-34
4.8	Chemical composition of base metal and filler wire	38
4.9	Heat treatment method with sample-wise distribution in test environments	43
5.1	Density, grain fineness number, weight loss and change in enthalpy for basic, rutile-basic and rutile-acidic flux systems	45
5.2	Thermal conductivity, thermal diffusivity and specific heat for basic, rutile-basic and rutile-acidic flux systems	46
5.3	ANOVA results of various physicochemical and thermophysical properties for basic flux system	47-52
5.4	ANOVA results of various physicochemical and thermophysical properties for rutile-basic flux system	53-57
5.5	ANOVA results of various physicochemical and thermophysical properties for rutile-acidic flux system	58-63
5.6	Optimized flux mixtures of different physicochemical and thermophysical properties for basic flux system	76
5.7	Optimized flux mixtures of different physicochemical and thermophysical properties for rutile-basic flux system	76
5.8	Optimized flux mixtures of different physicochemical and thermophysical properties for rutile-acidic flux system	76
5.9	Percentage error of different physicochemical and thermophysical properties for basic flux system	76
5.10	Percentage error of different physicochemical and thermophysical properties for rutile- basic flux system	77
5.11	Percentage error of different physicochemical and thermophysical properties for rutile- acidic flux system	77
5.12	Bead width, height and penetration analysis for three flux systems	84
5.13	Bead chemistry, average grain size and microhardness value for basic flux system	86
5.14	Bead chemistry, average grain size and microhardness value for rutile-basic flux system	87
5.15	Bead chemistry, average grain size and microhardness value for rutile-acidic flux system	88
5.16	ANOVA results for chemical composition, grain size and microhardness for multi-pass bead on plate for basic flux system	90-94
5.17	ANOVA results for chemical composition, grain size and microhardness properties of multi-pass bead on plate for rutile-basic flux system	95-99
5.18	ANOVA results for chemical composition, grain size and microhardness properties of multi-pass bead on plate for rutile-acidic flux system	100 105

Optimized flux mixtures of bead chemical composition, grain size and microhardness	117
properties for basic flux system	
Optimized flux mixtures of bead chemical composition, grain size and microhardness	117
properties for rutile-basic flux system	
Optimized flux mixtures of bead chemical composition, grain size and microhardness	117
properties for rutile-acidic flux system	
Percentage error of weld bead chemical composition, grain size and microhardness	118
properties for basic flux system	
Percentage error of weld bead chemical composition, grain size and microhardness	118
properties for rutile-basic flux system	
Percentage error of weld bead chemical composition, grain size and microhardness	118
properties for rutile-acidic flux system	
Distribution of heat treated specimens in various exposing environments	119
Corrosion rate of specimen due to weight loss in different test environments	125-126
Average microhardness values for different specimens under various testing	127-130
environments	
Impact toughness values of base metal and heat treated specimens (HT-1 & HT-2)	130
Corrosion rate of API X70 heat treated specimens in different environments	132
Chemical behaviour of seven weld specimen	136
Microhardness values of weld specimens	138
Impact behaviour of different weld joints	143-
	144
Base metal as well as weld metal tensile test properties	146
Measured crack parameters for base metal and weld specimens	148
Electrochemical corrosion behaviour of weld specimens	153
	properties for basic flux systemOptimized flux mixtures of bead chemical composition, grain size and microhardness properties for rutile-basic flux systemOptimized flux mixtures of bead chemical composition, grain size and microhardness properties for rutile-acidic flux systemPercentage error of weld bead chemical composition, grain size and microhardness properties for basic flux systemPercentage error of weld bead chemical composition, grain size and microhardness properties for rutile-basic flux systemPercentage error of weld bead chemical composition, grain size and microhardness properties for rutile-basic flux systemPercentage error of weld bead chemical composition, grain size and microhardness properties for rutile-basic flux systemDistribution of heat treated specimens in various exposing environmentsCorrosion rate of specimen due to weight loss in different test environmentsAverage microhardness values for different specimens under various testing environmentsImpact toughness values of base metal and heat treated specimens (HT-1 & HT-2)Corrosion rate of API X70 heat treated specimens in different environmentsChemical behaviour of seven weld specimensImpact behaviour of different weld jointsBase metal as well as weld metal tensile test propertiesMeasured crack parameters for base metal and weld specimens