EFFECT OF HEAT TREATMENT ON CORROSION BEHAVIOUR OF ALUMINIUM ALLOY 6061 BY FRICTION STIR WELDING

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Submitted by

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CERTIFICATE

This is to certify that the work contained in this thesis titled "**EFFECT OF HEAT TREATMENT ON CORROSION BEHAVIOUR OF ALUMINIUM ALLOY 6061 BY FRICTION STIR WELDING**" has been carried out by **EJAJ HUSSAIN.G** under my supervision and has not been submitted elsewhere for a degree.

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ABSTRACT

Friction Stir Welding (FSW) is a solid state joining process that involves joining of metals without fusion or filler materials. FSW applications are shipbuilding, aerospace, railway, electrical, automobile industries etc. Hence samples are welded at four different speed such as 800rpm, 900rpm, 1000rpm & 1200rpm. Thus the purchased plates is fabricated in the dimensions of 100*50*6mm as per the fixture shape and plates are welded together by butt joint of FSW. Hence welded samples are subjected to Heat treatment for 3-4 hours at 200-250 ^{o}C.

Thus Corrosion behaviour study is carried out after welding. Hence welded samples are subjected to pitting corrosion due to welding at Nugget region and welded samples of Aluminium Alloy (AA) 6061 plate are subjected into corrosion study with a help of potentiodynamic polarization study. In this study, there are three (3) electrodes that should be integrated to undergo the testing. The electrodes which involved in electrochemical cell would be working electrode (WE), reference electrode (RE) and calomel electrode (CE). Electrochemical corrosion test by Tafel extrapolation method was carried out on all welded samples of base alloy weld region of AA6061 in sodium chloride solution of 3% NaCl to determine corrosion parameters, such as corrosion potential (Ecorr) and corrosion current (Icorr). The corrosion rates of the material will depend on the corrosion current (Icorr).

Aluminium Alloy (AA) 6061 plate followed by Corrosion behaviour study is subjected to Microstructure examination. In order to examine the free defects from the surface of welding as well as to reveal the precipitation across the surface due to welding for all four samples and images are captured for precipitation as well as Micro-Hardness study Hence this microstructure study is examined with a help of Metallurgical microscope.

Finally Chemical composition of each welded samples are checked out in order to find out the nominal composition of most Aluminium percentage among all four samples. Chemical composition results gives the reason for corrosion rate influence for all welded samples. Chemical composition are checked with a help of Spectroscope machine.

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NOMENCLATURE

E	-	Potential in Volt (V)
i	-	Current in Ampere (A)
R	-	Resistance in Ohm (Ω)
Q	-	Charge passed (coulombs)
N	-	Number of electrons involved in the electrochemical reaction
W	-	Weight of electroactive species (gr)
M	-	Molecular weight (gr)
C.R. ($_{mpy}$)	-	Corrosion rate in milli-inches per year (mpy)
I_{corr}	-	Corrosion current density (μA/cm2)
E.W	-	Equivalent weight of the corroding species (g)
D	-	Density of the corroding species (g/cm3)
E_{stat}	-	Starting potential in Volt (V)
E_{end}	-	Final/End potential in Volt (V)
E_{corr}	-	Pitting potential in Volt (V)
I_{corr}	-	Pitting Current in (A/cm^2)
Rp	-	Linear Polarization Resistance in (Ohm)
b_a	-	Anodic Voltage in (V/dec)
b_c	-	Cathodic Voltage in (V/dec)
C. R	-	Corrosion Rate in (mm/y)

ABBREVIATIONS

FSW	-	FRICTION STIR WELDING
HT	-	HEAT TREATMENT
SEM	-	SCANNING ELECTRON MICROSCOPE
MM	-	METALLURGICAL MICROSCOPE
CP	-	CATHODIC PROTECTION
AA	-	ALUMINIUM ALLOY
HCHCr	-	HIGH CARBON HIGH CHROMIUIM
GTAW	-	GAS TUNGSTEN ARC WELDING
GMAW	-	GAS METAL ARC WELDING
MIG	-	METAL INERT GAS
HAZ	-	HEAT AFFECTED ZONE
TMAZ	-	THERMO MECHANICAL AFFECTED ZONE
BM	-	BASE METAL
EDS	-	ELECRO DISPERSIVE SPECTROSCOPY
OCP	-	OPEN CIRCUIT POTENTIAL
WE	-	WORKING ELECTRODE
RE	-	REFERENCE ELECTRODE
CE	-	CALOMEL ELECTRODE
RPM	-	REVOLUTION PER MINUTE
HCl	-	HYDROCHLORIC ACID
NaCl	-	SODIUM CHLORIDE
HNO_3	-	NITRIC ACID
HF	-	HYDROFLOURIC ACID

VH - VICKERS HARDNESS