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Joining of Stainless Steel with Novel Filler Material and its Weldability Studies †

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Abstract: Welding of Austenitic Stainless steels results in the emission of hexavalent chromium [Cr^{+6}] fumes due to the presence of 18-22% chromium content in the stainless steel base and its filler materials. These hexavalent fumes are carcinogenic and cause respiratory problems to the welders and personnel in the vicinity of welding. In the present research work, novel Chromium free Nickel-based filler material of % wt composition 41 Ni, 8 Co, 16 Fe, 14Mo, 7 Mn, 8 Cu, 3 Nb, 1 Ti, 1 Si, 1 Al is developed and its weldability with stainless steel is studied. The microstructure and chemical composition of different metallurgical phases in the filler material and weld joints are studied using different microscopy tools and X-Ray Diffraction, respectively. The ultimate tensile strength of the filler material and weld joint welded by developed filler material is found to be 536MPa and 487 MPa, respectively. The average hardness and toughness of the filler material and welded joint are 190VHN &110J and 209VHN & 89 VHN, respectively. Results of Potentio-dynamic polarization and Inter Granular corrosion cracking (IGCC) of the weld joint has shown the corrosion rate of 1.575e-004 mils/year and 354.56 miles/year, respectively. Mechanical properties and corrosion rate of weldments welded by novel filler material are compared with that of conventional filler material. Design of experiments(DOE) using Taguchi L9 array is formulated to understand the influence of Welding current, root gap, and gas flow rate on output parameters such as Tensile Strength, Toughness, and corrosion resistance of weldment. DOE using RSM has shown maximum Tensile strength of 487Mpa, maximum Hardness of 209 VHN, and a minimum corrosion rate of 1.575e-004 mils/year has obtained with an optimum current value of 130A, 11.79 litres/min gas flow rate, and 2.33mm root gap.

Keywords: stainless steel; filler material; welding; hexavalent chromium fumes; potentiodynamic polarization; Taguchi; intergranular stress corrosion cracking

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Conflicts of Interest

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