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A Project report on

"MITIGATION OF HEXAVALENT CHROMIUM FUMES DURING THE WELDING OF STAINLESS STEEL BY WELDING IT WITH NOVEL Cr-FREE WELDING ELECTRODE"

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ABSTRACT

The global market for welding electrode reached $19.3 billion in 2012 and is expected to reach nearly $25.1 billion by 2019 with compound annual growth rate of 5.2%, which leads to increasing air pollution. Hexavalent Cr fumes are the main welding product, which are carcinogenic in nature. Many research studies are carried out to reduce / eliminate Cr contents in weld electrode by alternative methods, but only few studies investigated for welding stainless steel with Ni and Cu based electrode. The objective of project was to characterize the stainless steel weld joint welded by Ni-Cu electrode for microstructure, mechanical and fracture.

The stainless steel SS304 and 316L are taken as base metal and welded by Ni-Cu based electrode of composition Ni, Cu, Fe, Mn, Si, Ti and C. Plates were welded by tungsten inert gas (TIG) welding technique. After welding, the specimens were tested for internal weld defects using X-ray radiography. The defect free weld joints were prepared and tested for microstructure, ultimate tensile strength, hardness, impact toughness, these tests were done by optical microscope, universal testing machine, Vicker hardness tester and impact testing machine. The elements and fracture surface of the specimen were identified using x-ray diffraction spectroscopy and scanning electron microscope respectively. And also the zones of welding were investigated namely, unmixed zone, mixed zone and heat affected zone after welding.

Results showed that all weld joints specimen failed at weaker unmixed zone, and weld joint welded by using TIG512 showed the highest tensile strength of 506.25 MPa and ductility of 58.01%. The material SS316L/TIG 512 revealed the highest impact toughness of 6.6% compared to SS304/TIG 511. The average hardness value of the joint welded by TIG 512 electrode is 4.37% lower compared to joints welded by TIG 511 electrode, which may be due to the formation of carbides in the weld joints. Tensile surface showed the ductile fracture under SEM micrographs. The micro structure of all specimens showed the fine dendritic structure with precipitates at its inter-dendritic regions and fine eutectic at grain boundaries. And the richest Cu-Ni chemical compositions can be seen on EDAX results. Finally the SS material welded with TIG 512 (Copper based) is more preferable than TIG 511 (Nickel based) by considering mechanical properties like Tensile, fracture, toughness and microstructure. Further this work can be extended for corrosion studies, fatigue and creep properties of the weld joint.