Seminar

==========

Institute for Plasma Research

==========

Title: Investigation on Friction Welding of Pipes for Dissimilar Metals

Speaker: Dr. Hardik Vyas

Pandit Deendayal Energy University, Gandhinagar

Date: 21st April 2023 (Friday)

Time: 03:30 PM

Venue: Join the talk online:

https://meet.ipr.res.in/join/3757728043?be_auth=NjY0Nzk4

(Conference ID: 3757728043; Password: 664798)

Abstract

Friction Welding (FW) is well established, a more economical, and highly productive method for joining similar and dissimilar materials such as aluminium, steel, copper, titanium, and magnesium. However, the formation of intermetallic compounds, deterioration of mechanical properties, and parametric effects are issues that need to be considered as challenges of dissimilar joint of FW.

In this case study, a dissimilar pipe system of Al-SS and Cu-SS FW is investigated for its joint properties and mechanism, microstructural changes, and process parameters. This project is sponsored by the Board of Research in Nuclear Sciences (BRNS), India and the project number is 39/14/02/2018-BRNS/39002. Here, a total of six configurations of pipe joints are investigated such as pipe dimension 1, pipe dimension 2, and pipe dimension 3 of Al-SS and Cu-SS. However, each pipe joint received more than 70% of joint strength except pipe dimension 1 in Cu-SS. In addition, to investigate FW parameters of rotational speed, time, and pressure, which leads to the observed effect on the joint properties and improves the mechanical strength meanwhile remaining process parameters of FW are kept constant. Moreover, in the past published articles, limited research articles are noted on pipe to pipe joints, whereas several articles reported solid to solid joints with the similar and non-similar metal duo to that reason, this research is unique compared to published articles.

The quality of the welds produced under the different process parameters is initially assessed by the visual inspection of flash morphologies and macrographs. After that, the welded specimens are subsequently evaluated with microstructural features, tensile properties, fracture analysis, hardness profile analysis, scanning electron microscopy (SEM), electron dispersive spectrographs (EDS), electron backscatter analysis (EBSD), and X-ray diffraction (XRD) analysis.

The present investigation reveals that in pipe configuration the welded samples passed in a vacuum and cryogenics test as per the requirement of the cryogenics heat exchanger application. Also, near the weld line, the flash formation is developed on the Al and Cu side only, whereas SS side no flash formation is reported. Throughout the experiment, soft materials are mounted on the stationary side, wherein the rotating side SS is fixed. Moreover, the microstructure variation is observed on the Al and Cu side while SS side limited variation is reported. Materials flow of Al 2 and Cu are affected by high pressure, temperature, and rotational direction of the SS metal. In a fracture surface investigation, the samples are broken into the interface and parent Al & Cu side. Also, the interface zone plays a significant role in the mechanical characteristics which leads to improving the tensile strength and hardness value. Involvement of the elements in the interface zone plays the dominant role in the characteristic of the joint, wherein equally distributed Fe, Al, and Fe, Cu elements in the faying zone improve the properties of the joint. Based on the mixture of the elements new intermetallics phases are developed in the interface area which is identified during the XRD test. These intermetallic compounds participated in the microhardness test due to the variation noted in the interface zone and nearer the welding zone.

Keywords:- Aluminium, copper, dissimilar metals, friction welding, joint properties, microstructure investigation, stainless steel.