

WEDNESDAY, AUGUST 24, 2005, P.M.

**SESSION 44: INTERNATIONAL SYMPOSIUM ON MATERIALS
DEGRADATION: INNOVATION, INSPECTION, CONTROL AND
REHABILITATION**

RESEARCH IN WEAR AND OTHERS II

Sponsor(s): Material Performance and Integrity Section, The Metallurgical Society of CIM

Room: Bannerman

Chair(s): A. ALFANTAZI, University of British Columbia, Canada

PAPER 44.1 — 14:00

DESIGN ASPECTS OF AUTOCLAVE BATTEN STRIPS.

D. WANT, W.E. Smith Hudson P/L, Australia

In titanium lined autoclave design the most critical point for its mechanical reliability is its titanium batten strips present at the circumferential and longitudinal barrel weld seams. Recently an Australian Company, W.E. Smith Hudson P/L, has developed a fully flush batten strip design and is currently building two autoclaves with this design. Significant research and development has been performed in the process. In this presentation design aspects of these batten strips are presented which cover topics such as residual stress magnitudes during fabrication, affect of preheat during batten strip welding and residual stress in respect to fatigue life. There has been little research done of the affects of residual batten stress in relation to fatigue life. Design considerations of this 'grey' area of design will be discussed based-on the author's research data and Finite Element Analysis.

RESEARCH ON COATINGS

Chair(s): A. ALFANTAZI, University of British Columbia, Canada

PAPER 44.2 — 14:25

CHARACTERIZATION AND EROSION OF PLASMA SPRAYED NI-20CR COATING ON A NI-BASED SUPERALLOY SUPERNI 75.

S. MISHRA, K. CHANDRA and S. PRAKASH, Indian Institute of Technology, India

Ni-20Cr metallic coating was deposited on a Ni-based Superalloy (3Fe-19.5Cr-0.3Ti-Balance Ni) by shrouded plasma spray process. NiCrAlY was used as a bond coat. Erosion studies were conducted on uncoated as well as plasma spray coated superalloy specimens using an air-jet erosion test rig at a velocity of 40m/s and impingement angles of 30 and 90. The coatings have been characterized in relation to porosity, microhardness and microstructure. Electron Probe Micro Analyzer (EPMA) was used to obtain X-ray elemental mapping of the coatings along the cross-section. X-Ray Diffraction (XRD), and scanning electron microscopy (SEM) techniques were used to analyze the eroded surfaces.

PAPER 44.3 — 14:50

CYCLIC OXIDATION BEHAVIOUR OF PLASMA SPRAYED STELLITE-6 COATED NI-BASE SUPERALLOYS IN AIR AND IN Na_2SO_4 -60% V_2O_5 ENVIRONMENT.

S. PRAKASH, D. PURI and H. SINGH, Indian Institute of Technology Roorkee, India

The oxidation behaviour of plasma sprayed Stellite-6 coating on Ni-base superalloys has been investigated in air and Na_2SO_4 -60% V_2O_5 environment by thermogravimetric technique at a temperature of 900 deg C for 50 cycles. The coating followed nearly the parabolic rate law in all the cases. Overall weight gain conceived in air was just 51% of that in the aggressive environment in case of coated Superni 75, whereas in case of coated Superni 600, the same was found to one-third of that in the Na_2SO_4 -60% V_2O_5 atmospheres. Further the coating showed very good adherence to the substrates during the air oxidation, whereas some cracks were observed near the edges of the specimens during the molten salt induced oxidation. XRD analysis revealed the presence of protective phases like CoO, CoCr_2O_4 and Cr_2O_3 in the oxide scales, which was further confirmed by SEM/EDAX and EPMA.

COFFEE BREAK — 15:15 – 15:30

PAPER 44.4 — 15:30

TRIBOLOGICAL AND CORROSION BEHAVIORS OF Al_2O_3 / POLYMER NANOCOMPOSITE COATINGS.

Y. WANG, Harbin Institute of Technology, Canada

S. LIM, J.L. LUO and Z.H. XU, University of Alberta, Canada

In this paper, the tribological and electrochemical corrosion properties of Al_2O_3 /polymer nanocomposite coatings were studied by using micro-hardness test, single-pass scratch test, abrasive wear test, and finally electrochemical technique such as potentiodynamic polarization measurement. The coatings containing Al_2O_3 nanoparticles showed improvement in scratch and abrasive resistance compared with that of polymer coating. The improvement in scratch and abrasive resistance is attributed to the dispersion hardening of Al_2O_3 nanoparticles in polymer coatings. Corrosion test results showed that the embedded Al_2O_3 nanoparticles in polymer matrix do not sacrifice the corrosion resistance of the polymer itself.

PAPER 44.5 — 15:55

EFFECT OF ALUMINA-SILICA SOL-GEL COATING ON THE HOT CORROSION AND STATIC OXIDATION RESISTANCE OF NICKEL SUBSTRATE.

A. GHASEMI, F. ASHRAFIZADEH and M.A. GOLOZAR, Isfahan University of Technology, Iran

In this research alumina silica coating was produced on nickel substrate by sol gel process. Effect of this coating on hot corrosion and oxidation resistance was investigated. For this purpose, substrates were surface finished and then dipped in a suitable sol. In order to produce the suitable silica coating appropriate drying and firing cycles were then applied on the substrates. Structure and uniformity of the coating produced were examined using glow discharge optical spectroscopy and EDAX. Hot corrosion and oxidation resistance of these coating were also examined. The result indicated that alumina silica coating could protect substrates from oxidation at 500°C, 700°C and 1000°C. Also coating could protect substrates from hot corrosion attack in 500°C, 700°C but it could not protect substrates at 1000°C.

PAPER 44.6 — 16:20

ALUMINUM PROTECTIVE COATING - FATIGUE AND BOND STRENGTH PROPERTIES WITH RESPECT TO SURFACE PREPARATION TECHNIQUES: LASER ABLATION, SHOT PEENING AND SAND BLASTING.

B. ARSENAULT, National Research Council, Canada

P. GOUGEON and M. VERDIER, Université de Technologie Belfort-Montbéliard, France

D.L. DUQUESNAY, Royal Military College of Canada, France

Aluminum coating can provide cathodic protection to several metal and alloys. In order to be a suitable protective solution on structural components, mechanical integrity must be preserved. Surface cleaning is a key step during coating manufacturing. Traditionally, surface contaminants such as organic and inorganic compounds have been removed by solvent-based products followed by grit blasting to provide good bond strength. However resulting fatigue properties are poor due to stress concentration at the coating substrate interface. To avoid such constraints, this work evaluates the benefit in term of fatigue and bond strength properties of the laser ablation in conjunction with shot peening and the Twin Wire Arc Sprayed Aluminum coating.

PAPER 44.7 — 16:45

EFFECT OF SUBSTRATE PRETREATMENT ON CORROSION RESISTANCE OF POLYPYRROLE COATED ALUMINUM ALLOY 7075.

A. ASHRAFI, M.A. GOLOZAR and S. MALLAKPOUR, Isfahan University of Technology, Iran

The electrochemical deposition of polypyrrole coating on different pretreated aluminum alloy 7075 substrates was carried out using cyclic voltammetry. The pretreatment of specimens consisted of mechanical polishing and/or electrochemical etching. In the latter case, an aqueous solution of Phosphoric acid and ethanol was used. The electrodeposition solution was 0.25M pyrrole and 0.1M oxalic acid in double distilled water. Cyclic voltammetry scan rate used was 700mV/sec. Morphology of coatings on different pretreated substrates as well as coating/substrate interface was examined using scanning electron microscope. Using Tafel experiments, corrosion resistance of coated substrates was investigated in 0.1M NaCl solutions. Results obtained revealed that electropolymerization of polypyrrole on 7075 aluminum alloy would increase the resistance against corrosion in 0.1M NaCl solution. Also it was observed that comparing with mechanical polishing, electroetching pretreatment would be more effective.