Omar S Es-Said, J Appl Mech Eng 2016, 5:3(Suppl)
http://dx.doi.org/10.4172/2168-9873.C1.001

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On the correlation of Charpy impact energy and hydrogen charging in 4340 steel

Three experiments were performed on the effect of hydrogen charging on the charpy impact toughness of 4340 steel. In the first experiment, 4340 steel plates were austentized and tempered to give the following target tensile strength values of: 1000, 1102, 1170, 1240, 1310, 1410, 1515, and 1720 MPa. Charpy impact samples were tempered at each of these temperatures. These samples were separated into uncharged and hydrogen charged samples. The charged samples were then plated with 0.0076 to 0.013 mm thickness layer of cadmium. It was found that samples tempered above 468°C and subjected to hydrogen charging exhibited lower impact energy values when compared to un-charged samples. No significant difference between charged and un-charged samples tempered below 468°C was observed. In a second experiment, steel plates were Electro Discharge Machined into twenty-four compact tension fracture toughness bars. These samples were divided into four groups: as-received, tempered, cadmium coated, and cadmium coated and tempered. The cadmium coating was 0.013 mm in thickness. The tempering temperatures were 354°C, 468°C, and 621°C, for two hours. Also, charpy impact samples were treated in the same way. A correlation between the fracture toughness and Charpy Impact values was obtained. In a third experiment tempered 4340 steel was hydrogen charged by cadmium plating of 0.005 mm, 0.0076 mm, and 0.013 mm. It was found that charpy impact energy was highest for the 0.005 mm and lowest for the 0.013 mm across all strength values. The results can be explained by the model of (hydrogen) atmospheres associated with mobile dislocations.

Biography

Omar S Es-Said is a Professor in the Mechanical Engineering department at Loyola Marymount University in LA, California. He was a full Professor from 1998 to present. He received his PhD in Metallurgical Engineering and Materials Science from the University of Kentucky, Lexington in 1985. His current research interests include metallic processing and modeling. He published over 300 papers. He has been an Associate Editor from 2008 to present for the *Journal of Materials Engineering and Performance*. He received several grants and awards for research funds for a total of over $3.6 million. He was a consultant for the Navy from 1994-2015 and a fellow of the American Society of Materials in 2005.

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