Ship Structure Committee Symposium 2011

Wednesday, March 16, 2011
George R. Brown Convention Center
Houston, TX

Presented by &
in conjunction with:

NACE International Corrosion 2011
Conference and Expo
The Ship Structure Committee’s purpose is to enhance the safety of life at sea, promote technology and education advancements in marine transportation, and to protect the marine environment. This is accomplished through advocating, participating in, and supporting cooperative research and development in Structural Design, Life Cycle Risk Management of Marine Structures, and Production Technologies.

Throughout its 60 year history, the SSC has established itself as a world recognized leader in marine structures with over 450 technical reports, a global membership of more than 900 volunteer subject matter experts, and a dynamic website.  http://www.shipstructure.org/

The SSC is a maritime industry and allied agency partnership that supports the pursuit of research and development to identify gaps in knowledge for marine structures. The SSC is comprised of 9 Principal Member Agencies which are as follows: the American Bureau of Shipping, U.S. Coast Guard, U.S. Maritime Administration, U.S. Military Sealift Command, U.S. Naval Sea System Command, Canadian Defense Research and Development Atlantic, U.S. Office of Naval Research, Transport Canada, and the Society of Naval Architects and Marine Engineers.

NACE International and the Ship Structure Committee (SSC) have partnered to bring presentations on maritime corrosion during a symposium as part of CORROSION 2011. The paper track program features significant practical and insightful works that address applicable research, testing, and development of corrosion regulations.

The US Department of Defense (DoD) Forum will be held in conjunction with the conference to discuss corrosion control challenges and solutions in all areas of service.

**Corrosion Protection Of Tanker Structures – Existing And New Challenges**

**Dragos Rauta, INTERTANKO**

**Abstract**

Some 20 years ago and even as recent as 10 years ago, the tanker industry was associated with large accidental oil spills. Today, the tanker industry is associated with safe, environmentally and increasingly sophisticated operations. This rapid evolution is the result of pressures exercised on the tanker industry from a combination of extreme liabilities and responsibilities, an avalanche of new regulations but, also of an imposed self-discipline which led to increase in standards of tank vessels structures, increase in the quality of crew training, significant improvements of ship operations and of new industry-safe practices.

The rapid evolution on tanker vessels standards is mainly the result of great contributions from all stakeholders: designers, builders, classification societies and ship owners but it has seldom attracted the general public’s attention and it has seldom been recognized. This paper intends to give an insight review of the last 10 years developments, including less known details but which indicate all changes and improvements were initiated and worked out by the industry itself.

The paper also shares some views on new challenges for the tanker industry and the shipping industry. These new challenges come as a result of a continuous struggle to improve ships’ environmental performance without having a negative impact on ships’ safety.
WEDNESDAY, MARCH 16, 2011
Registration 7:00am - 8:00am

I. WELCOMING REMARKS 8:00 – 8:30am
   (Conference room 352E)
   Mr. Delmar J. Doyle, P.E.
   NACE, Senior Director Global Operations
   LCDR Ronald Caputo (US Coast Guard)
   Executive Director, Ship Structure Committee

II. APPLICABLE RESEARCH
     8:30-11:30 (Conference room 352E)
     Moderator –
     “IMO PSPC Implementation in Shipyard and 15 Years of
      Target Useful Coating Life” C. Wei, J. Eliasson, E. Janson,
      G. Wang, and R. I. Basu (American Bureau of Shipping)
     “Impact of Tank Construction on Corrosion of Ship
      Ballast Tanks” K. De Baere, H. Verstraelen, L. Lemmens, S.
      Lenaerts, and G. Potters (Antwerp Maritime Academy)
     Break (10 Min)
     “High Solids Coatings Performance and Service History”
     M. Ingle (Naval Sea Systems Command)
     “Hull Structure Assessments of the USCG’s High
     Endurance Cutters, Application of Reliability
     Methodology to Aging Ship Structure” C. Cleary (US Coast
     Guard) (Presentation)
     Lunch 11:30-12:30 Show floor

III. TESTING
     12:30 - 2:00 (Conference room 352E)
     Moderator –
     “Mechanical Properties and Corrosion Resistance of Normal and High
      Strength Steels in Chloride Solution” A. Development of Test
Buckling Behaviour Of Randomly Corroded Stiffened Steel Plates Using Gaussian Distribution Under Uniaxial Compression

Zorareh Hadj Mohammad Esmaeil Nouri
PhD Candidate, Faculty of Marine Technology, Amirkabir

Abstract

This paper presents the results of an investigation into the post-buckling behaviour and ultimate strength of imperfect corroded steel plates used in ship and other marine-related structures. A series of elastic-plastic large deflection finite element analyses is performed on both-sides randomly corroded steel plates. The effects of general corrosion are introduced into the finite element models using a random thickness surface model considering Gaussian distribution with different standard deviation. The effects on plate compressive strength as a result of parametric variation of the corroded surface geometry are evaluated. A proposal on the effective thickness is concluded in order to estimate the ultimate strength and explore the post-buckling behaviour of randomly corroded steel plates under uniaxial compression.
Development of Test Specimens for Evaluating SCC Behavior of Marine Aluminum Alloys and Assessment of the Severity of Various Marine Exposure Conditions

Francine Bovard, Jerry Curran, Christine Henon, Jacob Padrul, Jim Towers, Cathy Wong, and Rebecca Wyss

Abstract

The excellent corrosion resistance of the 5xxx alloys is one of their most important characteristics. However, under certain conditions of elevated temperature exposure, alloys containing higher amounts of magnesium (>3%Mg) may become susceptible to intergranular forms of corrosion. The material specification for these marine sheet and plate alloys (ASTM B928) has lot acceptance requirements that invoke the use of nitric acid mass loss testing (per ASTM G67) to verify that the as-produced material is resistant to intergranular forms of corrosion.

An evaluation of the relevance of the mass loss in ASTM G67 to the in-service performance of high magnesium aluminum alloys is needed to validate the mass loss requirements in ASTM B928. However, uniaxial testing of thin gauge aluminum alloys in orientations other than short transverse (ST) cannot reliably predict SCC performance for in-service applications with an ST stress component. The objectives of this study were to identify a test specimen and evaluate various exposure conditions. The suitability of U-Bend specimens (per ASTM G30) to study stress corrosion cracking was established using 5083-H321 material that was thermally treated to intentionally create a sensitized condition. The testing, which was conducted at NASA Kennedy Space Center Beach Corrosion Test Site (BCTS), demonstrates the relative severity of seacoast atmosphere, full seawater immersion, seawater spray zone, and tidal exposures.

IMO PSPC Implementation In Shipyard And 15 Years Of Target Useful Coating Life

Chao Wei, Edward Jansen, Johnny Eliasson, George Wang and Roger I. Basu,
ABS Technology

Abstract

Coating corrosion protection is of critical concern to the marine industry and the recent regulations published by the International Maritime Organization (IMO) concerning protective coating in spaces of vessels is a reflection of this. The most recent regulations and standards (PSPC) are IMO Resolutions MSC 216(82), MSC 215(82), MSC.291(87), MSC.288(87) and MSC.289(87) for dedicated sea water ballast tanks, double-side skin spaces, and crude oil tanks.

Shipyards are responsible for IMO PSPC implementation and assembly of the coating technical file (CTF) during new construction. An inspection and coating process agreement shall be signed by the owner, shipyard and coating producer before commencement of any coating work on any construction stage. In addition to selections of qualified coating inspector(s) and qualified coating system, most important is quality control of surface preparation and coating application at every phase of new construction and harmonized with shipyard’s practice and experience of steel work and coating application. Use of qualified and certified coating inspector(s) is vital. This paper will focus on the key elements, relevant to shipyards during new construction, that affect useful coating life (the target is 15 years).
In Situ Study Of The Parameters Quantifying The Corrosion In Ballast Tanks And An Evaluation Of Improving Alternatives

Capt. K. De Baere, Mrs. H. Verstraelen, L. Lemmens, Phd, S. Lenaerts, Phd, G. Potters, Phd

Antwerp Maritime Academy

Abstract

An in situ study of more than 100 ballast tanks of merchant navy vessels throws another light on the corrosion process in these tanks. The developed corrosion model shows major similarities with earlier studies based on laboratory experiments. The field work exposes the influence of ship construction parameters such as land of construction, coating type and the presence of sacrificial anodes on the corrosion process in the ballast tanks. Possible alternatives for vessels constructed with ordinary grade A steel and coated according to IMO PSPC standards are presented, even though further research is required to come to final conclusions.

Buckling Behaviour Of Randomly Corroded Stiffened Steel Plates Using Gaussian Distribution Under Uniaxial Compression

Zorareh Hadj Mohammad Esmaeil Nouri
PhD Candidate, Faculty of Marine Technology, Amirkabir

Abstract

This paper presents the results of an investigation into the post-buckling behaviour and ultimate strength of imperfect corroded steel plates used in ship and other marine-related structures. A series of elastic-plastic large deflection finite element analyses is performed on both-sides randomly corroded steel plates. The effects of general corrosion are introduced into the finite element models using a random thickness surface model considering Gaussian distribution with different standard deviation. The effects on plate compressive strength as a result of parametric variation of the corroded surface geometry are evaluated. A proposal on the effective thickness is concluded in order to estimate the ultimate strength and explore the post-buckling behaviour of randomly corroded steel plates under uniaxial compression.
Development Of A Stress Corrosion Test Specimen For Determining The Stress Corrosion Resistance Of Aluminum 5XXX Marine Alloys

Thomas, J. Summerson
Consultant

Abstract

ASTM Task Group B07.03/G01.09 needed a stress corrosion test specimen for relating nitric acid mass losses (ASTM G67) cited in ASTM B928 to stress corrosion resistance in marine environments. (Note: ASTM B928 was established in 2004, following an inspection survey in 2002 of several boats exhibiting SC cracks in hull and deck plates of 5083-H321. B928 is intent is to prevent use of alloy/temper that are not shown to be resistant to intergranular corrosion.)

This paper describes how a preform/stressed specimen configuration was found to serve this purpose.

Results of Point Loma, CA atmospheric tests of preformed samples of sensitized 5083-H321 in both sheet and plate thicknesses are provided.

This lead to the ASTM Task Group current use of a modified preform specimen configuration (U-bend) for more extensive SC tests of 5XXX alloys with varying mass loss values.

High Solids Coatings Performance And Service History

Mark Ingle, Paul Slebodnick and James Martin, James Ellor and Patrick Cassidy

Abstract

In the mid-1990’s, the Navy identified corrosion repair and preservation within tanks and voids as their primary maintenance cost of corrosion issue, consuming nominally $250 million per year. In response, the Navy instituted an aggressive program to study the root cause of these corrosion problems and implement solutions. The Navy program demonstrated that:

(a) Early 1990’s coating installation practices tended to limit the life of the coating systems.
(b) Legacy, solvent-based coating materials being utilized were not state of the art.
(c) Coatings tended to fail initially at “edges” (e.g., stiffeners, welds, etc.) within tanks.

Legacy coating materials were most commonly the solvent-based polyamide epoxy coatings (e.g., those meeting U.S. military specification MIL-DTL-24441 Type III or IV). The multi-coat systems applied at the time required three to five full and stripe coats. These coating systems, and their commercial equivalents based on solvent-based MIL-PRF-23236 tank coatings had an expected service life of roughly five years to eight years (in ballast, fuel/compensated fuel, and potable water tanks), but sometimes as little as two years (as in waste holding tanks and potable water tanks). In the mid-1990’s these service life expectations correlated well with ship drydocking maintenance periodicities.
Mechanical Properties And Corrosion Resistance Of Normal Strength And High Strength Steels In Chloride Solution

Ahmad Rahbar Ranji*, Seid A. H. Zakeri
Amirkabir University of Technology

Abstract

The corrosion resistance (weight loss) and mechanical properties (yield strength, ultimate strength and elongation) for three carbon steels, normal strength and high strength steels using tension test are investigated. The specimens are kept in chloride solution (20% NaCl) up to 240 hours. At every 48 hours, thickness and weight loss is measured and tension test is carried out. It was found that the susceptibility of the steels to corrosion based on their weight loss were identical prior to 144 hours, after that was accelerated for high strength steel. In addition, it was found that manganese (Mn) has reduced corrosion rate at early stage of corrosion. The change in mechanical properties by corrosion for all steels are the same, and ultimate strength is reduced, which for limit state design of aged structure should be taken into account.

Development Of Edge-Preparing Plasma Arc Cutting (EPPAC) System

Prof. Osawa, Naoki, Mr. Akira Furujo, Mr. Masayuki Nagahori, Mr. Toshitake Onishi, Mr. Hiroyuki Yajima, Mr. Takeshi Miyamoto

Abstract

Edge-Preparing Plasma Arc Cutting (EPPAC) systems have been developed. Top edges of kerfs generated by these systems have bevel angle 155°, which is equal to or larger than that of 3-path grinding edges. Cutting qualities except for melting of cut shoulder equivalent to or better than those of kerfs generated by conventional machines, and there is no slowdown on the cutting speed. The developed systems are tested under the practical condition in Japanese shipyards, and it has been demonstrated that there is no special problem in workplace safety, and kerfs which satisfy the requirements specification can be generated with high stability. The lower bound of 95% confidence interval of edge retention ratio (ERR) of kerfs generated by EPPAC systems is about the same as that of 3-path grinding edges. This means that the top edge shape of kerfs generated by developed EPPAC systems conforms to IMO/PSPC, and there is no need of additional hand grinding. We can cut the man-hours for edge treatment in half by using developed EPPAC systems.