11–12 October 2012, Riga

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Dedicated to the 150th Anniversary and The 1st Congress of World Engineers and Riga Polytechnical Institute / RTU Alumni

DIGEST

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RIGA TECHNICAL UNIVERSITY
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Perspectives of Ship's Hull Diagnostics Using Acoustic Emission Method

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***Keywords* – acoustic emission, ship hull strength, cracks in ship structures.**

I. Introduction

Present paper shows most important reasons for acoustic emission (AE) method implementation in shipping industry, particularly in ship hull and crankshaft cracks detection. If we are speaking about large container carriers, than before 20 years it was vessel with appr.4000 TEU and length appr.250m, before 10 years- appr.6000 TEU and length appr.300m, today- more than 14 000 TEU and appr.400m. It is clear than such constructions are affected by different loads. And constructions strength not always is calculated correct. [1]

II. Types of ship's stress

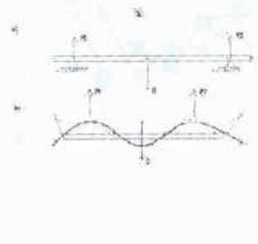
All ships live circle her hull and other structures are under different forces influence .as: wave generated, cargo generated (loading and discharge), accidental loads from contact with floating object, pier, seabed etc.

In general stresses in ships we can divide:

a) Longitudinal stresses
b) Torsion
c) Transverse
d) Local (mostly ship bow)
e) Collapsing stresses (due to cargo weight on ship bottom- that force tends to draw ship sides together. If ship is in dry dock- effect is opposite).

III. Common and distinctive in ship types

Simplistic we can accept ship hull as beam which is subjected by complex of loads.



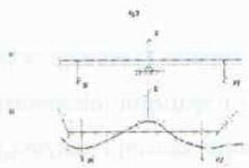


Fig. 1. Simplified waves effect to the ship hull

Depending on ship type also stresses influence to ship structures are different. Bulk cargo carriers- ocean going vessels are mostly 50 000- 300 000 dwt (Handysize- Panamax- Capesize) with large hatchways and machinery space aft. Such design significantly effect bending moments as during cargo operations in port as in open sea. Correct cargo operations are essential for these vessels. The IACS (International Association of Classification Societies) research shows than 10% overload could increase bending moment up to 40%. In modern port facilities 10% overload could be reached in 5- 7 minutes. It is necessary to take in to account high corrosion risk for bulk carriers as some cargo has aggressive effect to the metal constructions

Container carriers- usually are single deck vessel with large hatch openings. Machinery space for smaller vessels is aft, larger- about ¼ from aft. Ocean going ships today carry 4000-14000 TEU. Such design produces mostly longitudinal and torsional stress (from unsymmetrical loading) as well ship structures twisting in a seaway

IV. Acoustic emission method implementation

Today ultrasonic is well known in shipping industry but mostly in concerns ship hull and construction thickness measurements. AE method implementation for ship hull stress limit definition is little studied. In a last half year there was several cases where AE method was able to help reveal cracks in their early stages, in this way to protect owners not only from large financial losses but also from indirect losses

. In the laboratory status it is easy to apply AE method for crack detection in beam at a very early stage- fixing sensors on the beam. It is also possible detect AE limit when material collapse. The same principle is proposed to use for cracks detection in the ship hull and structures

V. Conclusions

There were first steps made last spring in this field. AE sensors was fixed on Riga Port Authorities tug "Sfinksa" main engine (Caterpillar, Ne=,2 x 1500 kW, n= 1600 n^{-1}). The goal was to fix AE waves from main engine crankshaft. Due to high revolutions and small engine dimensions with existing hardware the first attempt was unsuccessful. In spite of this negotiations with some shipping companies and engines manufacturers concerning this matter are in progress.

VII. References

[1] Murawski L,.Szmyt M. Stiffness characteristics and thermal deformations of the frame of high power marine engine. Polish Maritime Research, vol. 14. 2007.