The Story of SOHIC

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The Story of SOHIC

A 30 year story
Nearing its final chapter.

Contents
History of SOHIC
OTI 95 635
Case Histories
The “NEW” Plate test method
The Final Chapter
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Definition:-

Stress Orientated Hydrogen Induced Cracking.

Also

Ladder Cracking
Stacked Array of Cracks
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First identified in the early 80’s

Research study for Hoesch Steel

Developed Spiral Pipe for Sour Service

Two Papers published
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Adjacent to SAW weld in Spiral Pipe

Using early form of the Full Ring Test

Resulted in thermal treatment of Spiral weld
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OTI 95 635
Development

Joint Industry Project
Supported by 22 Companies

Method Published by the
UK Health & Safety Executive.
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Full Scale Pressure Tests
V
Full Rings

Validation Process
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Essential Features

Correct Loading Direction
Retention of Residual Stress
Large Size Sample
On Line Crack Detection

Parent Material and Associated Welds
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SAFETY

Laboratory must be able to deal with large volumes of Hydrogen Sulphide

- Fully Detected and Alarmed systems required
- Proven Deaeration Procedures (1000 litres)

- Qualified Strain Gauge Operatives.
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FUTURE

An ISO Standard

A work group has been proposed.
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CRITICAL FACTOR - RESIDUAL STRESS
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Failures? Nine reported!
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- Not all Spiral Welded Pipe
- One ERW pipe failed in Germany
- SOHIC in Pressure vessel steel also reported by Exxon
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- Fittings thought to be immune
  - Three case histories
    - All “soft”
    - Clean
  - Good microstructure
    - Heat treated
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Dished End
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Reducer
The History and Development of SOHIC

The Concern

- The fittings were all tested as HIC coupons with NO applied stress!
  - And for 96 hours

- NACE HIC Test Method now revised to include guidance on how to test fittings and flanges.
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Test Methods

OTI 95 635 for Line Pipe

NACE TM0103 for Plate (NOW WITHDRAWN)

ISO 15156 part 2 cites alternate methods such as Four Point Bends and Tensiles?
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Test Method Development

Joint Industry Project

Bodycote (now EXOVA)
TWI
Force Institute.
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Sponsors

UK H&SE
Chevron
Saudi Aramco
Rockwater
Dalmine
Shell
Hydrogen Ion Science
BEB (Exxon MOBILE)
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Followed by:-

Two Internships from Aalen University

Two Research Students from Industry
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Test Method Development

Aims

Go/No Go test

Short Duration

Simple Interpretation
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Rig Design Requirements

Controlled Twist

Controlled Tensile Load

Reproducible!
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New SOHIC Test Rig
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Results
Control 2deg and 5deg twist
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Results

Application of between 2 and 5 degrees of twist
Combined with Four Point Bend loading of 50% SMYS

Stimulates SOHIC in susceptible material.

First Commercial Tests Undertaken
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The Future

Validate Test Method – on-going

Produce written procedure Complete

Consider JIP to study the SOHIC mechanism now that a true test method is available.
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JIP

Variables to consider:-

HARDNESS

- Microstructure
- Chemistry
- Weld and HAZ properties
- Level of Hydrogen charging
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Conclusions

History of SOHIC described

Case Histories presented

New Test Method Outlined
Thank You
Any Questions