The Fastener Engineering and Research Association
www.fera.org.uk

FERA Seminar

Wednesday 27 September 2006

Focus on Construction

11.20 – 12.00 **Stress Corrosion Cracking – How to Recognise the Problem**
Mark Hayes, Senior Metallurgist
Institute of Spring Technology

Stress Corrosion Cracking – How to recognise the problem

Mark Hayes, Senior Metallurgist, IST

Stress Corrosion Cracking

Some names given to this and similar failure modes

Hydrogen Embrittlement

Hydrogen Assisted Stress Fracture

Stress Embrittlement

Delayed Failure

Static Fatigue

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Stress Corrosion Cracking

Some names given to this and similar failure modes

Are these synonyms?

No, but the similarities between outweigh the differences

Stress Corrosion Cracking

Names given to this and similar failure modes

Similarities

Sudden and unwarned fracture

Delay between assembly and failure

Brittle fracture mode initially becoming more ductile

Understood by few

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Names given to this and similar failure modes

Differences

SCC and HASC are due in part or whole to corrosion in service. SCC is not always due to Hydrogen.

HE and SE are due to hydrogen ingress during manufacture

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Stress Corrosion Cracking

Diagnosis

Fractures may be rusty if they occurred and were not noticed soon after failure

Such fractures if not pitted by corrosion may be electro-cathodically cleaned

Only affects steels with hardness > 300Hv

SEM required for certain diagnosis

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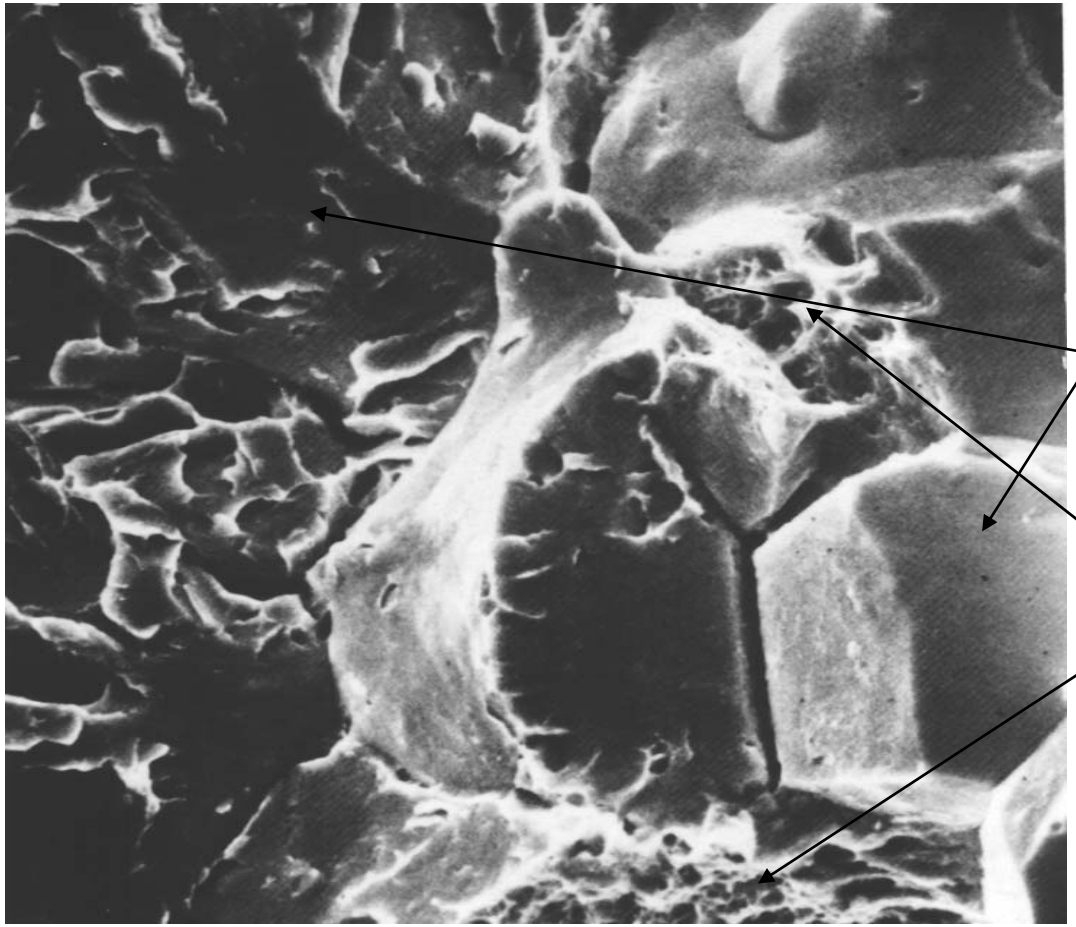
Fracture Characteristics as seen on SEM



Brittle initially

(intergranular)

More ductile

(transgranular)

Finally ductile,
(maybe with
shear lips)

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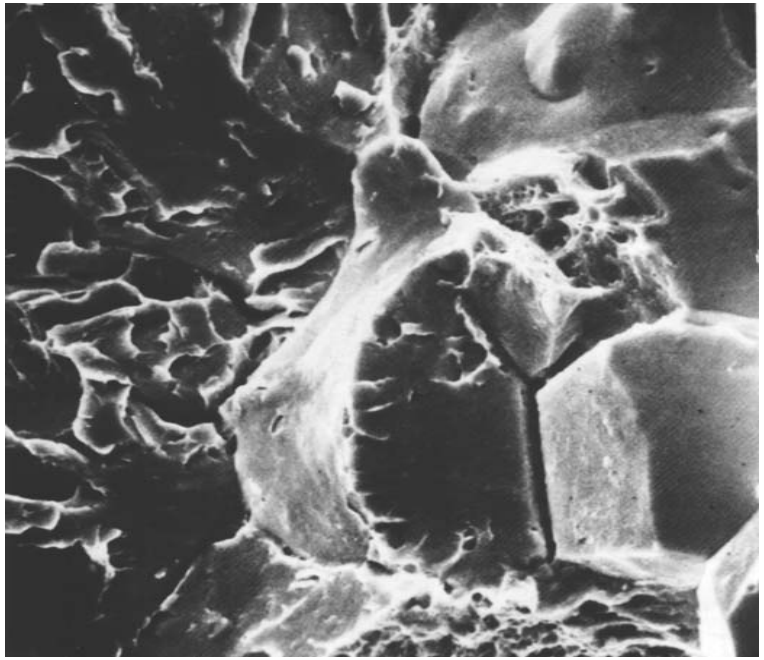
Fracture Characteristics as seen on SEM



Intergranular fracture thoughout fracture or in case indicates brittleness from heat treat

Transgranular or cleavage arises due to impact loading

Ductile or dimpled failure, sometimes called microvoid coalescence by metallurgists is caused by overload.

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Diagnosis –how can steel become embrittled with hydrogen?

Electolytic process such as electroplating

Contact with acid

In acid cleaning

In phosphating

In Corrosion when conditions at the base of a crevice or pit become acidic and oxygen access is restricted.

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How can it be avoided?

Use steel with hardness < 300Hv

Avoid simultaneous stress and corrosion

Don’t acid clean or electroplate

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How can the risk be reduced?

Use lower tensile steel

Reduce the exposure to corrosion

Reduce the applied stress

Alkali or mechanically clean

De-embrittle after plating according to ISO 9588

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How can the risk be reduced?

Don’t believe platers who say they have never encountered the problem

Presence of zinc does not guarantee immunity from SCC – corrosion of zinc in a crevice will cause hydrogen emission if the conditions are right.

Commission failure analysis if the worst happens – half the cases IST investigates where HE is suspected have another cause.

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