

The Effect of Hydrogen Behavior on Environmentally Assisted Cracking of Vessel Steel SA508C1.3 in High Temperature Water Environment

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< > 288°C

가 가 ,

가 da/dt vs. d /dt ,

가 가 , 가

가 가

가 MnS .

가

가

<Abstract> The corrosion fatigue tests were performed at 288°C water with varied loading frequencies to explain the onset of brittle crack propagation. The crack growth rate was increased

with decreasing frequency until a critical frequency. The strain rate effects on the crack growth rate was investigated by means of da/dt vs. crack tip strain rate curves. At intermediate range, there was a transient point corresponding to the onset of dynamic strain aging, where an abrupt increase in the crack growth rate was observed. Above the transient point, small size particles enhanced brittle cracks while only large size particles enhanced brittle cracks below the transient. The sectioned area of the specimen showed that microcracks were formed by strain localization along slip bands in the crack tip yielding zone. Further, there were a void growth due to a strain localization and a tensile ductility loss due to brittle facets around microcracks when the specimen was precharged by hydrogen. From these results, it is suggested that environmentally assisted crack (EAC) could be enhanced at a specific strain rate, and that EAC may be related to interactions of hydrogen with oxide film and to the Luders band movement with a high strain gradient at inclusion/matrix interface.

I.

SA508 C13

Mn- Ni- Mo

가

[1-4].

가

가

가

가,

가

가

가

가

가

[5, 6].

300

[7 - 12].

가

[13, 16].

가

[17].

II

1.

SA508 Cl. 3
 1 880 7
 , 655 9 1
 (Lath)가 (Upper Bainite)

2.

ASTM E647 Autoclave water loop [17],
 SEM

3.

288°C

24 mm 4 mm 가
 0.1M H_2SO_4 + 200(mg/l)As $_2$ O $_3$
 30mA/cm 2
 (- 1.6Vshe) 10
 Cu As- received H- charged 150, 200, 250, 288°C 7 ×
 10 $^{-4}$ 4 × 10 $^{-3}$

III

1.

2 288 da/dt vs. crack tip strain rate(CTSrate)
 가

, CTS rate (f)

가 . ,

10

가 , 0.01 - 0.05 Hz

가

가 1Hz

()

0.05Hz

가

가

가

Plateau가 , 0.05 Hz

Plateau가 CTSrate Plateau

CTSrate Plateau

가

가

2 da/dt vs. CTSrate . 0.05 Hz

, CTSrate가 5×10^{-4} (s) 2×10^{-3} (s)

. 5×10^{-4} (s) - 2×10^{-3} (s)

0.1 Hz 1 Hz 0.05 Hz

Ford- Andersen 1 가

[10]. CTSrate 288 가

[3].

[17].

3 CTSrate MnS

[13- 15]. CTSrate 가

가

CTSrate , MnS

MnS

가

가

가

가

20 μ m

가

가

4(a)

4(b)

가

가

가 [18].

가

가

가 가 [15].

가가

가

2. As- received

5

6

As- received

, 150

가

가 가

(+SRS : positive Strain Rate Sensitivity)

, 200

(- SRS : Negative Strain Rate Sensitivity)

, 250

H- charged

, 200

가

가

As- received

가

가

가

가

가

, 200

3.47×10^{-3}

가

가

, 150

가 . 25
0 , As - received
H- charged , 가

7, 8 9 가
7 250 , 가
Shear Lip ,
가 8
9 288 , As - received H- charged
, H- Charged

250 As - received H- charged
가 , (Void)가
가 Flow Stress
, 250 As - received
Flow Stress , 250
,
, As - received

250
가
3.
가
[19,20].
가

CTSrate
3 K CTSrate CTSrate
가 가 가
가
0.05Hz
가 가 가 [1-4].
가 가 가 [2].
가 가 [1],
Atkinson 가 가 [6].
가

가 가 [1], 가

VI

1. 가 가

2. 가

3. 250 가

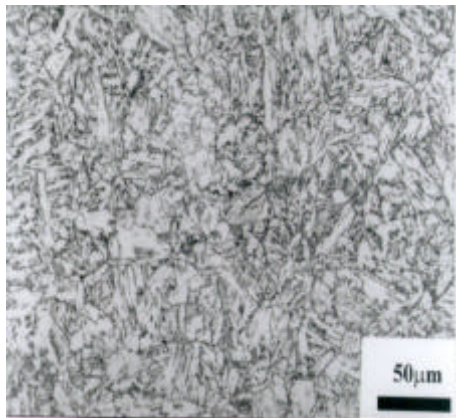
4. 가 가 , 288
 가 가 0.05 Hz
 가 가 .
 2001 21 .

References

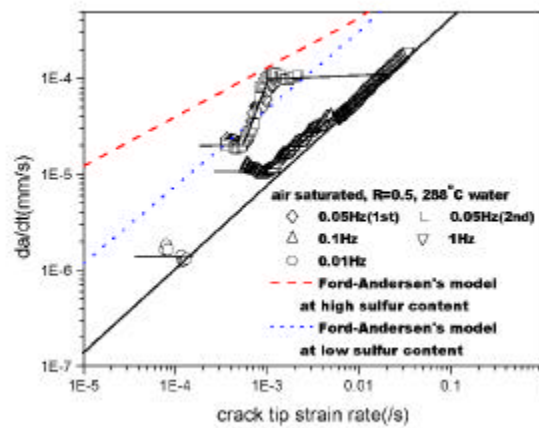
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Table 1. The compositions of SA508 Cl-3

	C	Si	Mn	S	P	Ni	Cr	Mo	Al	Cu	V
(wt/o)	0.21	0.25	1.24	0.002	0.007	0.88	0.21	0.47	0.008	0.03	0.004

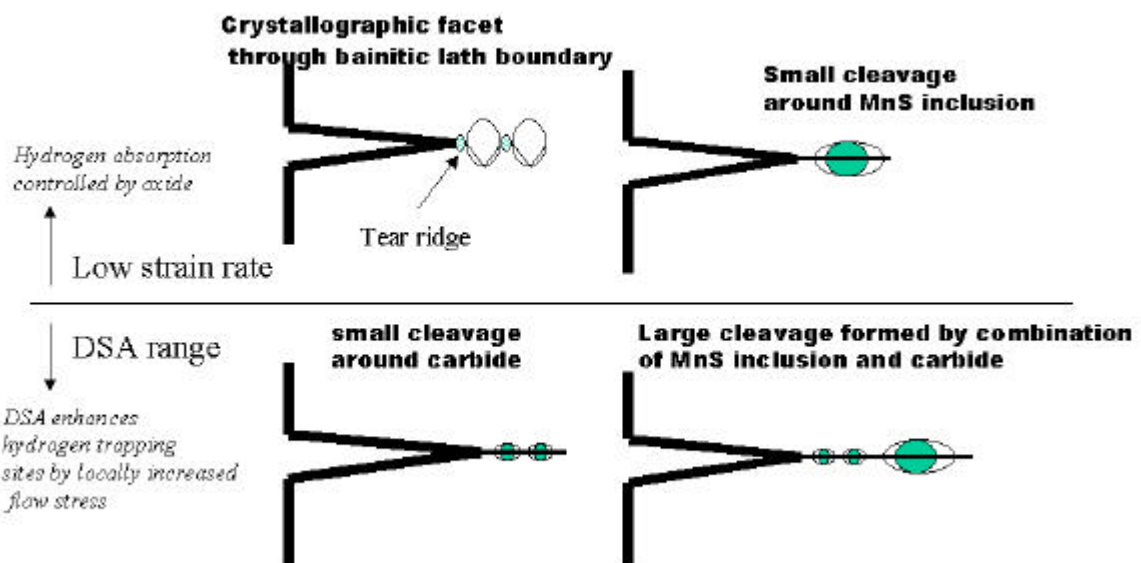


1. SA 508 Cl. 3



2.

SA 508 Cl.3



3.