Behavior of Dynamic Strain Aging for Superalloys

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1. Introduction

Superalloys have been used at IHX and hot gad
duct of VHTR because the operating temperature
is 950°C for VHTR. Many candidate superalloys
for application to VHTR have been studied in
other country (France, Germany, USA, Japan).
Mechanical and microstructure of superalloys are
degraded because alloys are aged at high
temperature during operation. Dynamic strain
aging (DSA) is a factor that decreases the high
temperature mechanical properties because DSA
increases strength but decreases ductility. In this
study, DSA behaviors of superalloys are
investigated and compared.

2. Experimental procedure

Superalloys for test are commercial Hastelloy-
X, Alloy 617, Haynes 230. Chemical
compositions of alloys are satisfactory to ASME
range. Tensile tests were conducted at RT-
1000°C and strain rate was 2x10^-3/s. Tensile test
specimen was 2mm thick, 6.25 mm width, 25 mm
gauge length. All tests were conducted at air
environment.

3. Results

Tensile strength and elongation are show in Fig.
1. Yield stress and UTS are not greatly different
with alloys but elongation of Haynes 230 is the
worst especially at high temperature.

Serration was shown in 300-800°C temperature
range in Fig. 2. Serration is a evidence for DSA.
Elongation was decreased in the temperature
range which DSA was occurred but increased at
above 900°C which DSA did not occur. Temperature range of Hastelloy-X for DSA is lower than those of Alloy 617 and Haynes 230. The magnitude of serration from top to bottom was shown in Table 1.

DSA of Hastelloy-X was severe at high
temperature but Alloy 617 was not severe, Haynes
230 was sever at low and high temperature because tensile strength was increased but

![Fig. 1. Tensile properties of superalloys](image-url)
Fig. 2. Tensile curves for superalloys

Table 1. Stress change for serration

<table>
<thead>
<tr>
<th></th>
<th>∆σ, MPa</th>
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<tbody>
<tr>
<td></td>
<td>500 ℃</td>
</tr>
<tr>
<td>Hastelloy-X</td>
<td>8</td>
</tr>
<tr>
<td>Haynes 230</td>
<td>19</td>
</tr>
<tr>
<td>Alloy 617</td>
<td>20</td>
</tr>
</tbody>
</table>

4. Conclusion

Yield stress was not different with alloys (Hastelloy-X, Alloy 617, Haynes 230). Elongation of Haynes 230 was decreased at above 900 ℃. The temperature range for serration was 300-800 ℃. Alloy 617 was the most resistant to DSA.

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