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"Development of Residual Life Diagnosis Method by Strain for 9%Cr Steel Welding Steam Piping"

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Abstract
At the present time, many Extra Super Critical Pressure Boiler are made by 9%Cr steel for thermal power station in Japan. These power station have been in operation for a total of over 100,000 hours, Actual-Size Burst Equipment capable of reproducing actual equipment damage (Type IV damage)and FEM are used to solve this burst mechanism.
Worlds first time, Residual Life Assessment Method from middle Life able to use Welding part at 9% Cr steels was developed. Type IV mechanism for 9%Cr Welding Part was solved. In detail, 3 pattern existed. First pattern is clack starts from nearly surface, Second pattern is clack starts from nearly bottom, Third pattern is clack starts from bottom. In every pattern, Surface Strain is largest.
The reasons that Different Crack Pattern occurred were caused by different load and shape of welding part.
For example, Surface Strain of Steam Pipe in One thermal Power Station is Max and Clack occurred nearly Surface.
Region of unable to assess residual life still had been exited. It was Steady Creep region. But If using $\acute{\varepsilon}min \times tr = \varepsilon f$, Residual Life can assess. It is defined Tr is Burst Time, εf is Burst Extend of Multi Axis and $\varepsilon f0$ is Burst Extend of Mono Axis,
$\varepsilon f = \varepsilon f0 \times$ Multi Axis Correction $\times$ Stress Correction. Multi Axis Correction is transformed from Maximum Stress to Limited Strain. Stress Correction is transformed from Mono Stress to Multi Stress, In detail, It is correction of Extend Drop Rate, Using Spindler, CocKs&Ashby, Rice&Tracy Formula.
We tried to search Burst Extend of Multi Axis (εf) from each Company Test Date.
In the result, It was about all same value 1.16. Steady strain rate (ε min) is measured by Laser Device that consist of usual setting target and main body setting at Periodic Inspection.
Heat Influence for HAZ in TIG Welding of Laser Device Fitting Set was little, 1mm depth.
We confirmed accuracy of this method using Mono Axis Test Piece, In the result, Burst Time expected by this one is 4926 hours, Real Burst time is 5000 hours, Its accuracy is Factor of 1.015.
In conclusion, We developed high accuracy Residual Life Diagnosis Method in the worlds first,
It is consisted of combination Strain considered Multi Axis Burst Extend and Micro structure in %Cr steel HAZ.