Enhancing 9Cr-Mo Steel Creep Life Assessment Accuracy using Physical Properties

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Creep life assessment holds significant importance for materials used at high stresses and high temperatures. The current assessment is based on calculations and microstructural changes. An ordinary replica technique is used for tracing the carbides and micro-voids formed both intragranular and along the grain boundaries. Missed operations could occur at any point such as preparation of the microstructure, replicating the microstructure, taking micrographs, and evaluation of the microstructures. These steps pose relatively high assessment uncertainty approximately ±20%.

To overcome that issue, the On-Site Extraction Replica (OSER) and the Direct Current Potential Drop (DCPD) have been developed. Since the composition of carbide has a relationship with the life of materials, the OSER could pull the carbides from the microstructures for chemical analysis. The physical changes of materials such as the formation of carbides, voids, and micro-cracks could be measured using the DCPD. By implementing of both techniques, the creep life assessment of the 9Cr-Mo could be determined. As a result, the uncertainty could be reduced to about ±10%. This could be beneficial for the improvement of integrity assessment. In addition, more precise life assessment could help to prevent pre-mature decommissioning of the high-temperature materials which in turn, saves the lifetime cost of the equipment.