High Temperature Strength Considerations for Ultrasupercritical Steam Boiler Materials

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Summary (50 words or less)
The high temperature strength (creep strength) of commercially available (Haynes® 230), modified/controlled chemistry (CCA617/Marco 617), and new (INCONEL® 740) alloys and weldments is being investigated for determining the maximum operating conditions in Ultrasupercritical Steam Power boilers. Microstructural analysis is being used to further understand the structure-properties relationship in these materials.

Abstract

The demand for higher efficiency and reduced emissions in coal-fired power boilers will result in the use of higher steam temperatures and pressures. A significant materials effort is required to reach a target steam condition of 760°C/35MPa. These new Ultrasupercritical (USC) units will require the use of nickel-based superalloys. Long-term creep strength will be a determining factor in achieving the highest possible steam conditions. To this end, the creep strength, including weldments, of commercially available (Haynes® 230), modified/controlled chemistry (CCA617/Marco 617), and new (INCONEL® 740) alloys are being investigated at Oak Ridge National Laboratory (ORNL). Creep tests at ORNL show that the CCA617 provides a significant improvement in strength over the standard alloy 617 at 650°C to possibly 750°C. The strength of alloy 230 is well characterized, thus the testing on 230 has focused on specific specimen configurations for evaluating the high temperature behavior of weldments. Creep testing on INCONEL® alloy 740 and a modified composition 740 has shown good strengths (higher than 230 or CCA617) that may meet the target steam conditions. Microstructural analysis on aged and tested material is being used to further understand the structure-properties relationship in these materials and determine long-term stability of the microstructures.

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