LONG-TERM HIGH TEMPERATURE OXIDATION BEHAVIOR OF ODS FERRITICS -- B. A. Pint and I. G. Wright (Oak Ridge National Laboratory)

To be published in the Journal of Nuclear Materials as Proceedings of the 10th International Conference on Fusion Reactor Materials, October 2001, Baden-Baden, Germany.

EXTENDED ABSTRACT

Four oxide dispersion strengthened (ODS) Fe-(13-14 at.%)Cr- ferritic compositions were exposed in air and air with 10 vol.% water vapor for up to 10,000 h at 700°-1100°C. At 700°-800°C in air, the reaction rates were very low for all of the alloys compared to stainless steels (types 310 and 347). At 900°C, a dispersion of Y_2O_3 in Fe-14%Cr-0.9%W (labeled FCW-Y), compared to a dispersion of Al_2O_3 (labeled FCW-Al), showed a distinct benefit in improving the oxidation resistance, due to a reactive element effect, Figure 1. However, a Y_2O_3-dispersed alloy with only 13%Cr (labeled FCW-YT) failed after 7,000 h at 900°C due to its smaller Cr reservoir, which is depleted by the formation of the Cr_2O_3 surface oxide. The absence of Ti and W in one alloy appeared to result in a thinner reaction product after oxidation at 800°C. One composition (FCW-Y) was exposed in 10% water vapor at 800° and 900°C and in air at 1000°C and 1100°C. In the presence of water vapor, volatilization of CrO_3 or $CrO_2(OH)_2$ occurred, resulting in mass loss (Figure 1) and increased metal wastage due to the continuous loss of the reaction product. A significant increase in the rate of attack also occurred for the higher temperature exposures in air. Overall, it appears that the corrosion-limited operating temperature in air of these relatively low Cr content alloys is below 900°C.

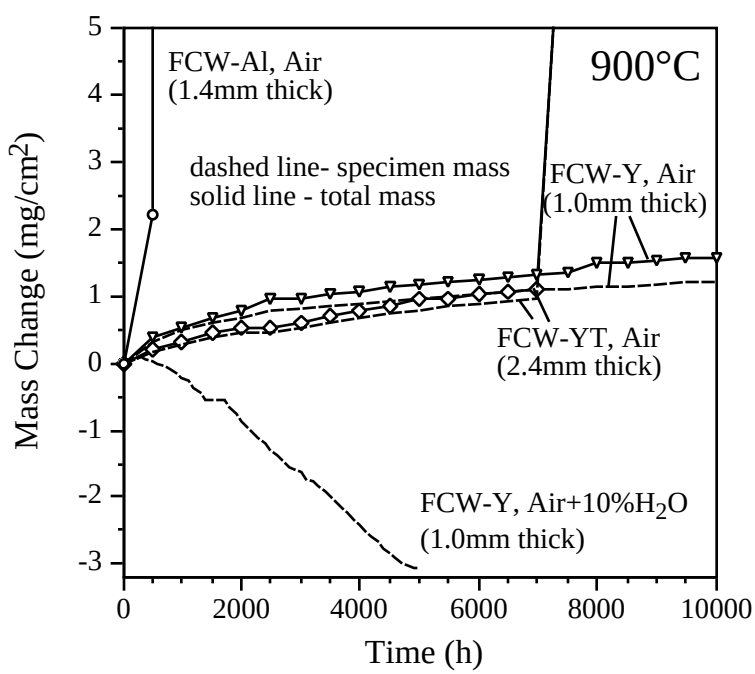

Figure 1. Total (solid lines) and specimen (dashed lines) mass gains measured at 900°C in air and air with 10% water vapor. The specimen thickness is shown for each. The addition of water vapor to the test resulted in mass losses for FCW-Y compared to exposure in air.