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Corrosion of Stainless Steel 316 in Phosphoric Acid Solutions at 600°C and 25 MPa.

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Corrosion of stainless steel and Ni-base alloys under temperatures and pressures higher than the critical point of water (374°C, 22.1 MPa) is important for new processes for treatment of organic mater in supercritical water. Educts range from hazardous wastes to biomass.

Corrosion of alloy 625 in supercritical water containing phosphoric acid and high concentration of oxygen has been extremely fast. A complicated corrosion mechanism has been proposed. These new experiments will clarify some aspects of the corrosion under similar conditions.

Experiments have been performed with tube reactors made of SS 316 with 14.4 mm outer diameter and 8 mm inner diameter. Phosphoric acid with both industrial quality and analytical quality has been used. No hydrogen peroxide or oxygen have been used. Acid concentration was between 0.7 and 2 mol/kg. Industrial quality phosphoric acid has been simulated by a solution containing H₃PO₄, H₂SO₄ in the ratio 1 to 0.17 and some ppm Cl⁻. The temperature ranged from 20 to 650°C. The pressure was constant at 25 MPa. The exposure time was 2 up to about 6 h.

After exposure, the whole tube reactor has been examined by metallography. For surface analysis optical microscopy and SEM with EDX (energy dispersive X-ray analysis) have been used. Soluble corrosion products have been analyzed by ICP.

The solid corrosion products clogged the reactor after only few hours of operation and lead to premature end of the experiments. Results show high corrosion rates in the temperature range about 470 °C. General corrosion and pitting with several 100 µm penetration depth have been observed.

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