U.S. Nuclear Waste Technical Review Board (NWTRB)

CORROSION DURING THE THERMAL PULSE

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Board Meeting, May 18, 2004

Washington, DC

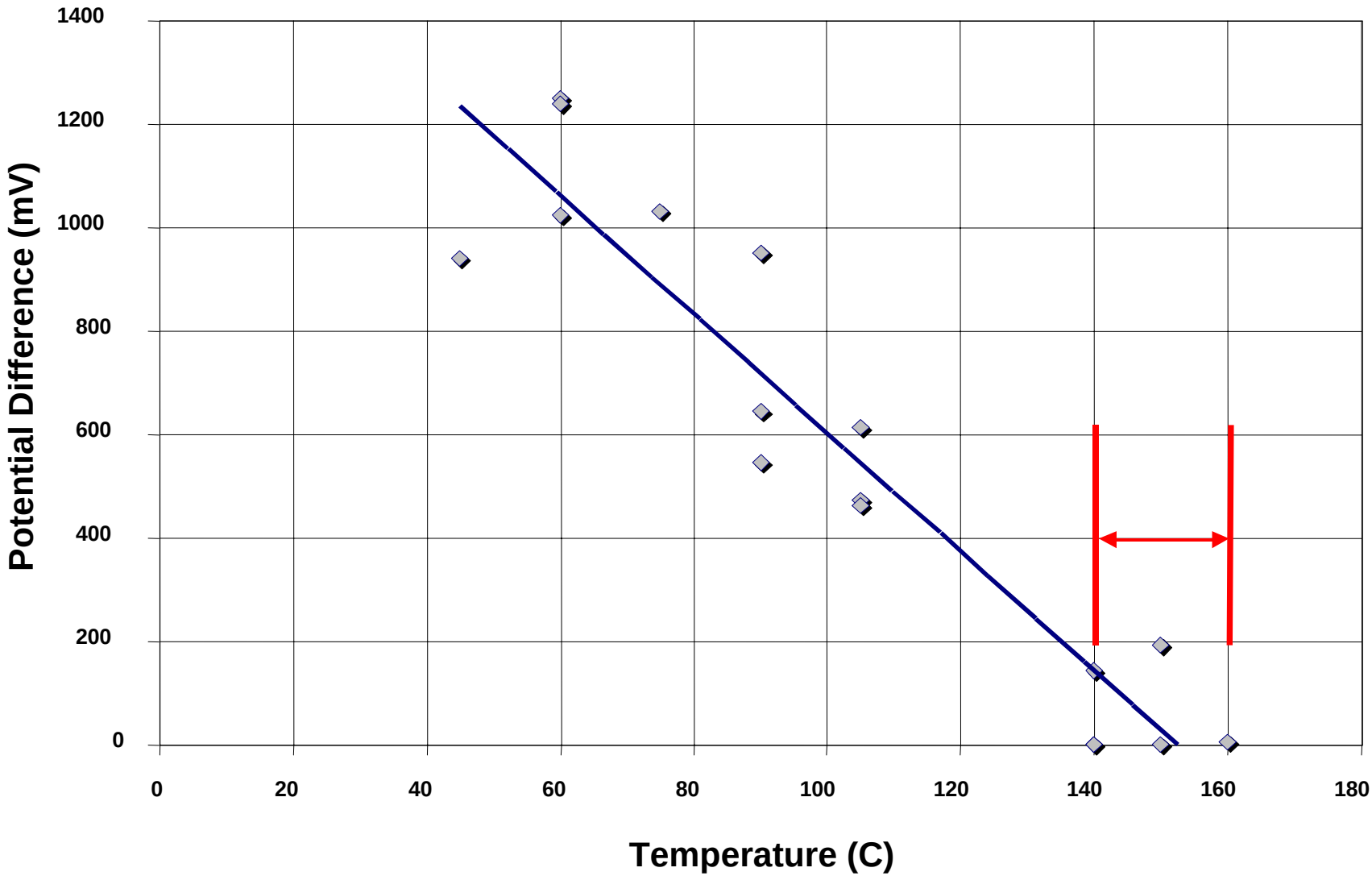
Outline

- Localized corrosion
- Generalized corrosion
- Implications
- Research

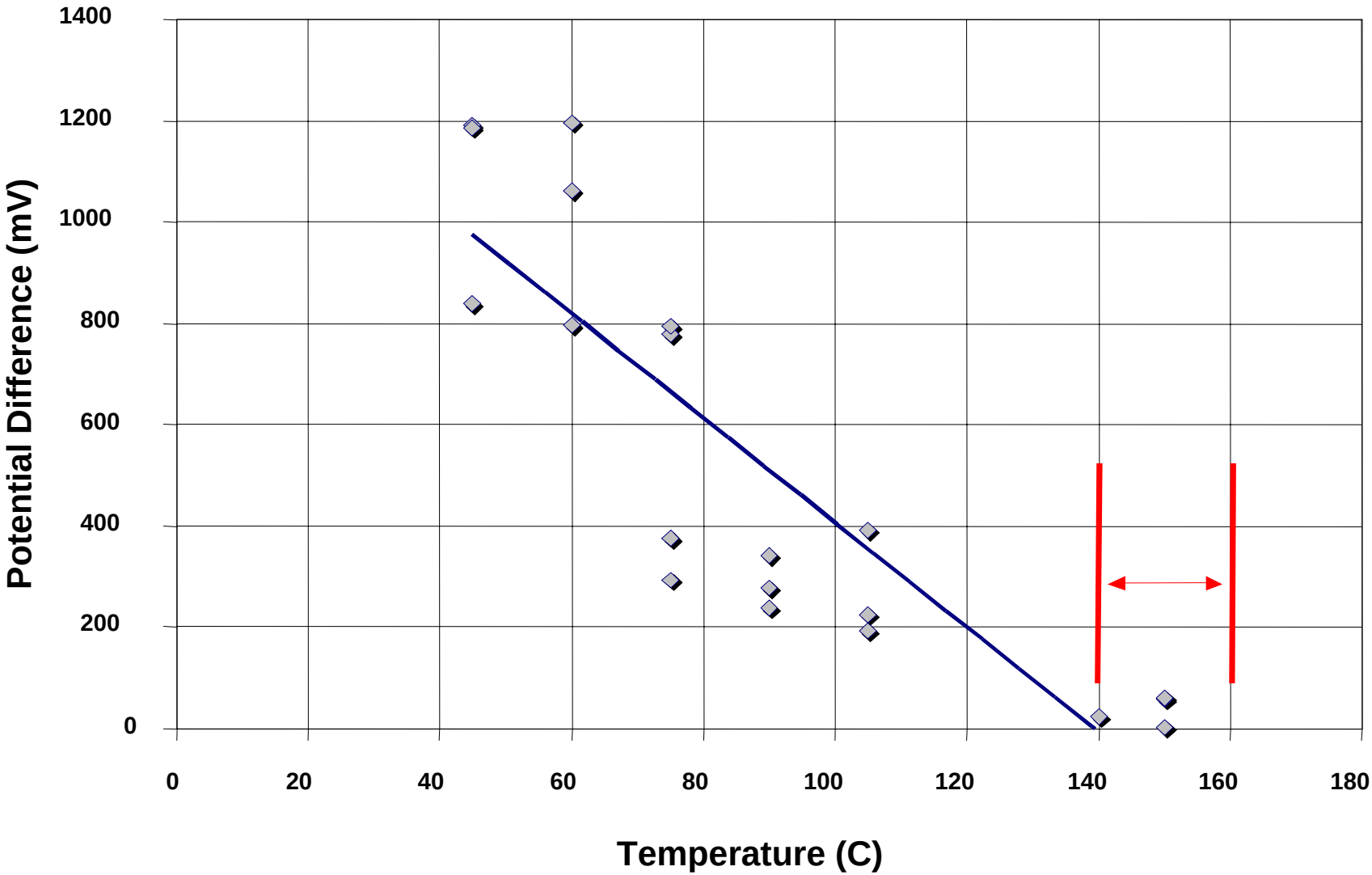
Localized Corrosion

- Insidious
- Critical potential
- Open circuit potential
- Difference between the two

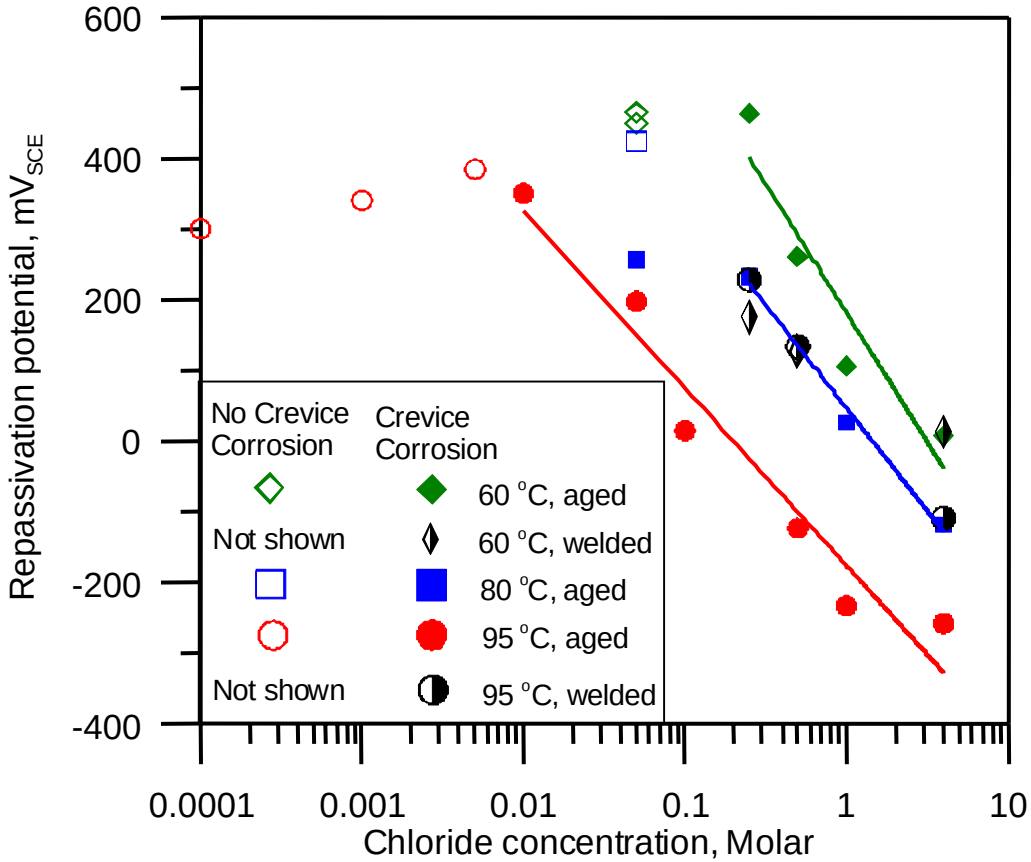
CP of Alloy 22 in $CaCl_2$ Brines (Nitrate Added)



CP of Alloy 22 in $CaCl_2$ Brines (No Nitrate)



Effect of Fabrication Processes on Localized Corrosion



- Welding and short-term thermal aging increase localized corrosion susceptibility
- Localized corrosion observed at lower [Cl^-] and lower temperatures compared to the mill annealed condition

Generalized Corrosion

- Long-term data
- Temperature dependence
- Short-term electrochemical data
- Data not fully utilized

Implications

- Significantly reduced safety margin
- Multiple-barrier concept weakened
- Reduced confidence

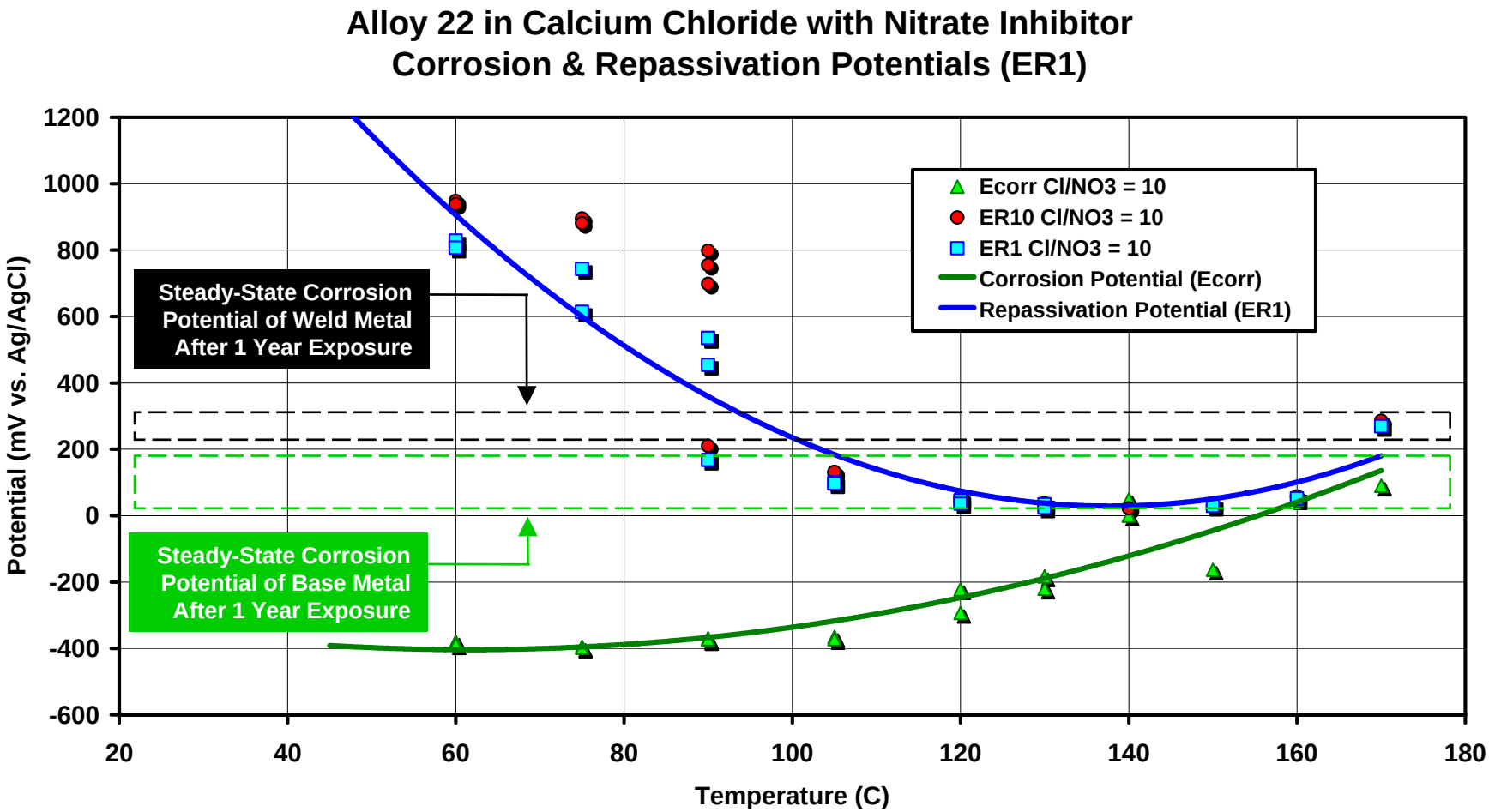
Research

- Expected repository environments
- Crevice corrosion propagation
- Thermogravimetric tests
- Nitrate
- Data mining

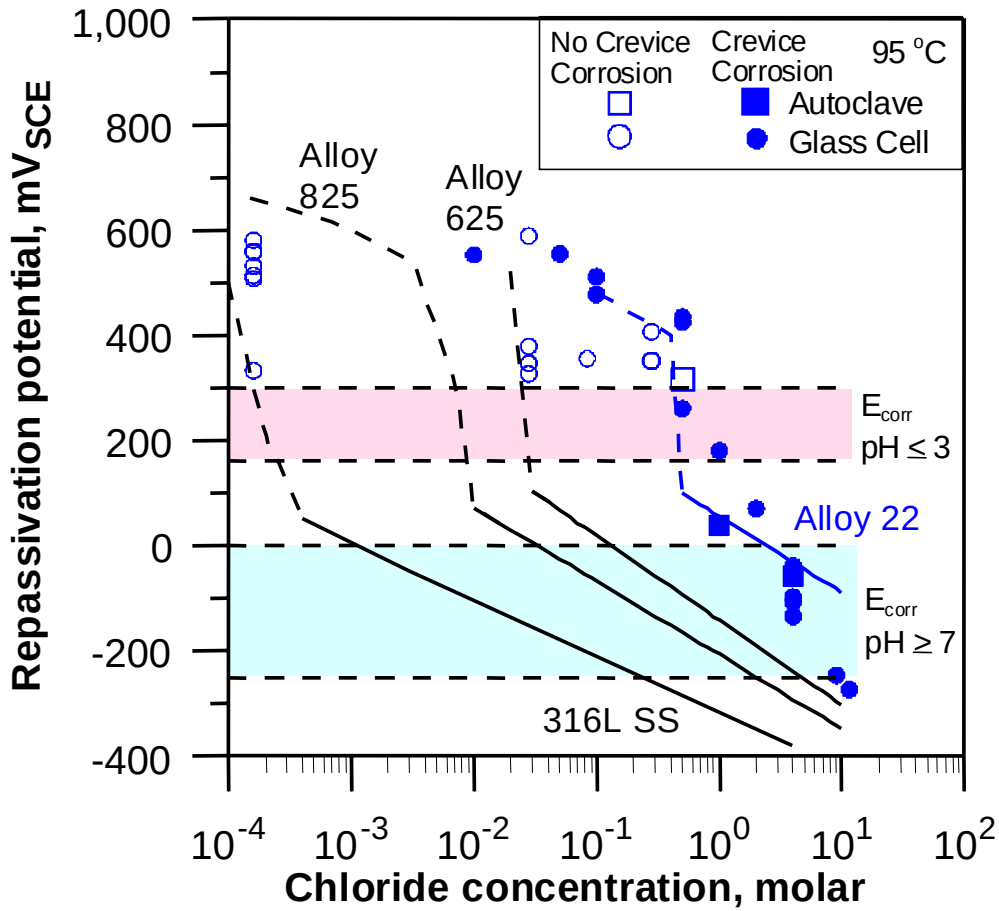
Backup Overheads

- (From Board letter of October 21, 2003)

Critical Temperature for Localized Corrosion in Artificial $CaCl_2$ Brine with NO_3^- Inhibitor

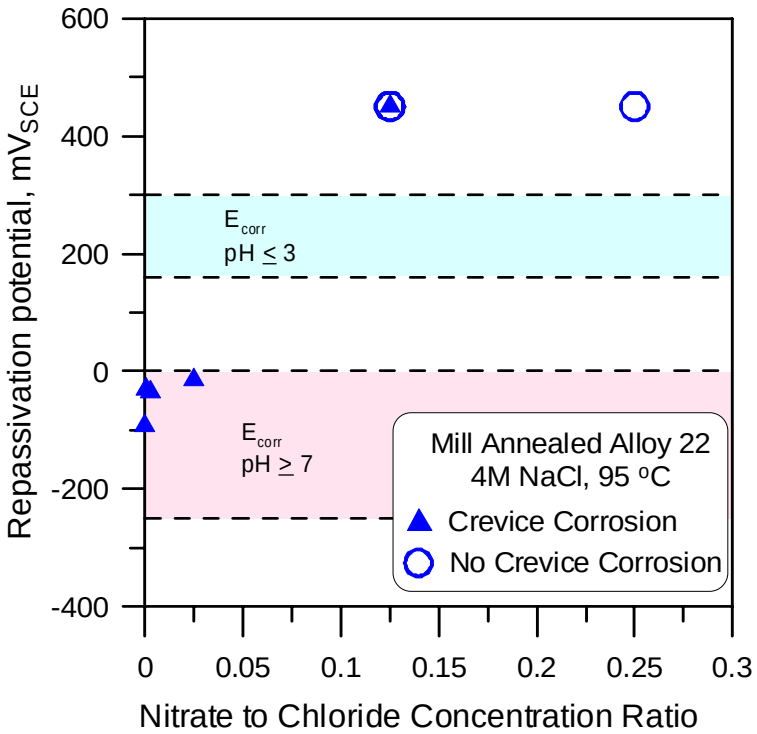


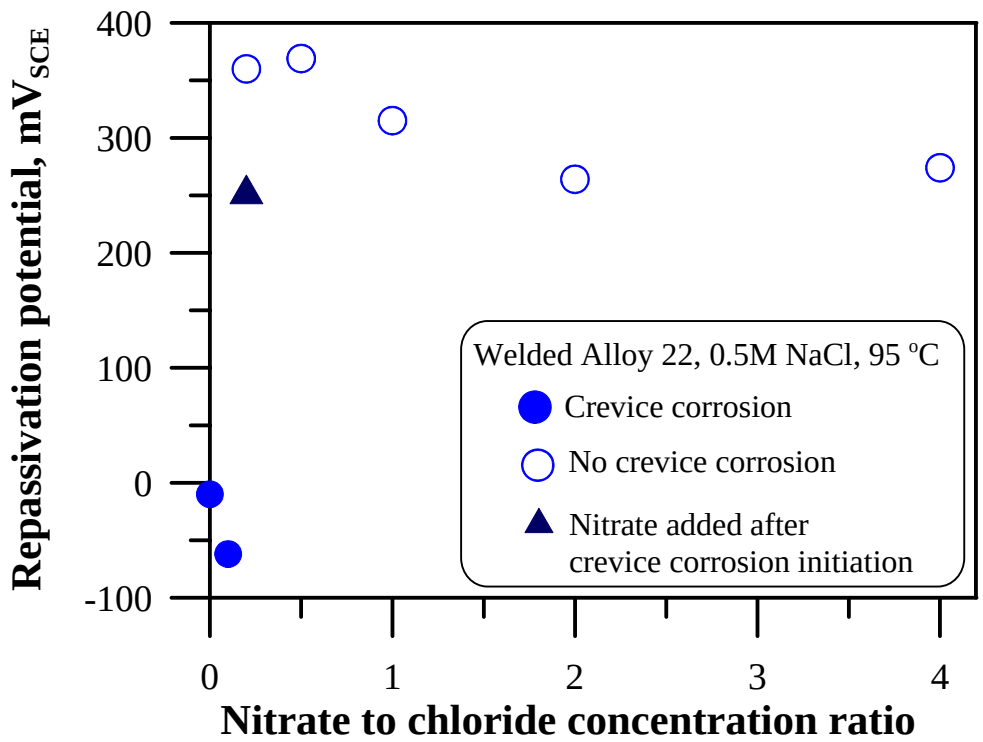
Localized Corrosion of Mill-Annealed Alloy 22



- Alloy 22 in the mill annealed condition is quite resistant to localized corrosion in chloride solutions
- Increased resistance with respect to other Ni-Cr-Mo alloys is due to the high Mo (and W) content of Alloy 22

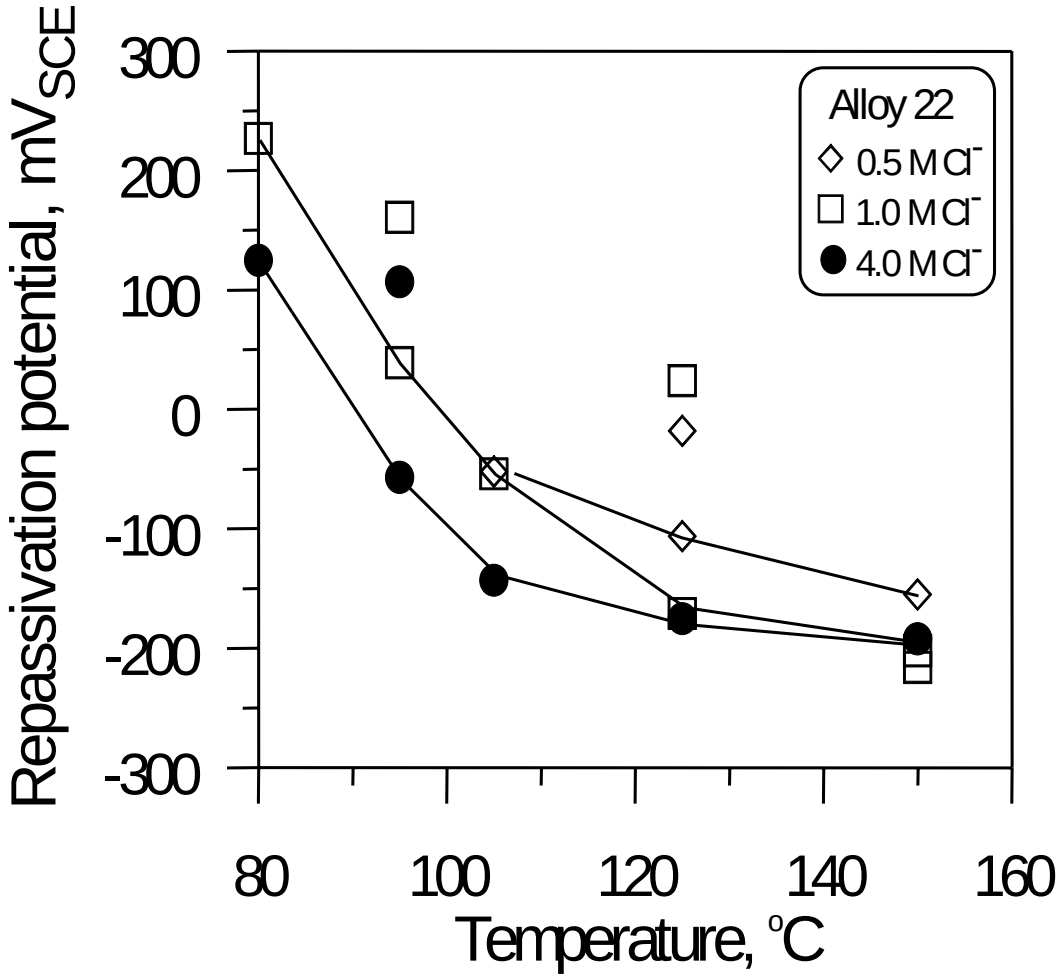
Effect of Nitrate on Localized Corrosion of Alloy 22





- Nitrate is an efficient inhibitor of localized corrosion induced by chloride
- Critical nitrate to chloride molar concentration ratio is 0.12 for mill-annealed material and 0.2 for welded material

Effect of Temperature on Localized Corrosion



- E_{rcrev} measured using creviced specimens in autoclave systems
- Significant decrease of E_{rcrev} with increasing temperature from 80 to 105 °C
- At higher temperatures E_{rcrev} values tend to level off