



Corrosion of Alloy 22 in Salt Environments at Elevated Temperatures

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Presentation Key Points

- Preliminary experiments were conducted in NaCl-
NaNO₃-KNO₃ system:
 - 150 to 180 °C
 - Representative drift conditions (ambient pressure, no deaeration)
- General corrosion was the major mode of attack for Alloy 22
 - General corrosion rate was from 1 to 10 μm/yr
 - Uncertainties exist in susceptibility to localized corrosion

Background

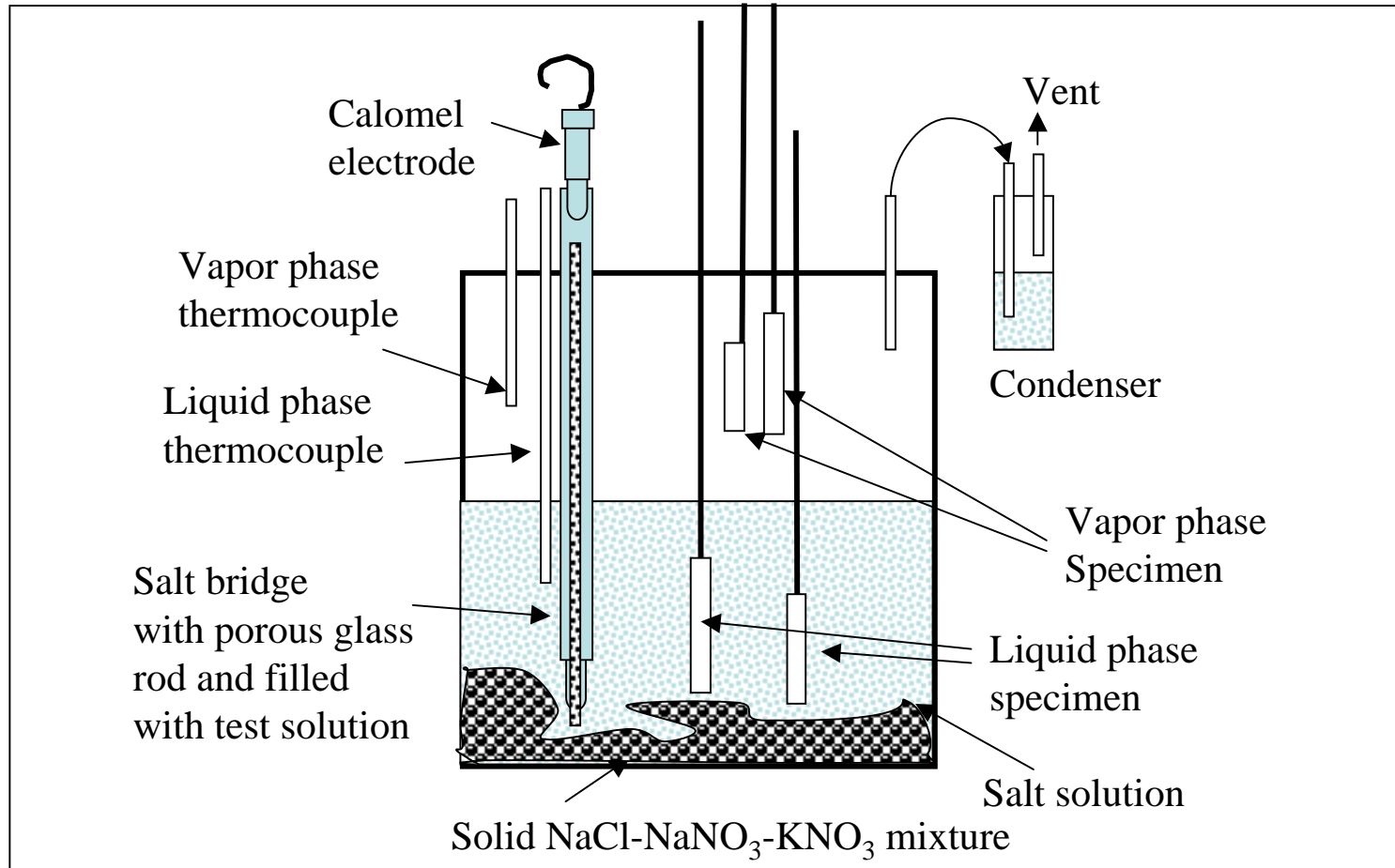
- NaCl, NaNO₃, and KNO₃ are present in atmospheric dusts*
- NaCl-NaNO₃-KNO₃ system is highly deliquescent
 - Boiling point >220 °C (428 °F)**
- Maximum temperature at waste package surface***
~203 °C (397 °F)
- Deliquescence may take place during dry thermal period
- Corrosion of Alloy 22 in nitrate-chloride salts may affect WP lifetime

* National Atmospheric Deposition Program Website Data, May, 2004.

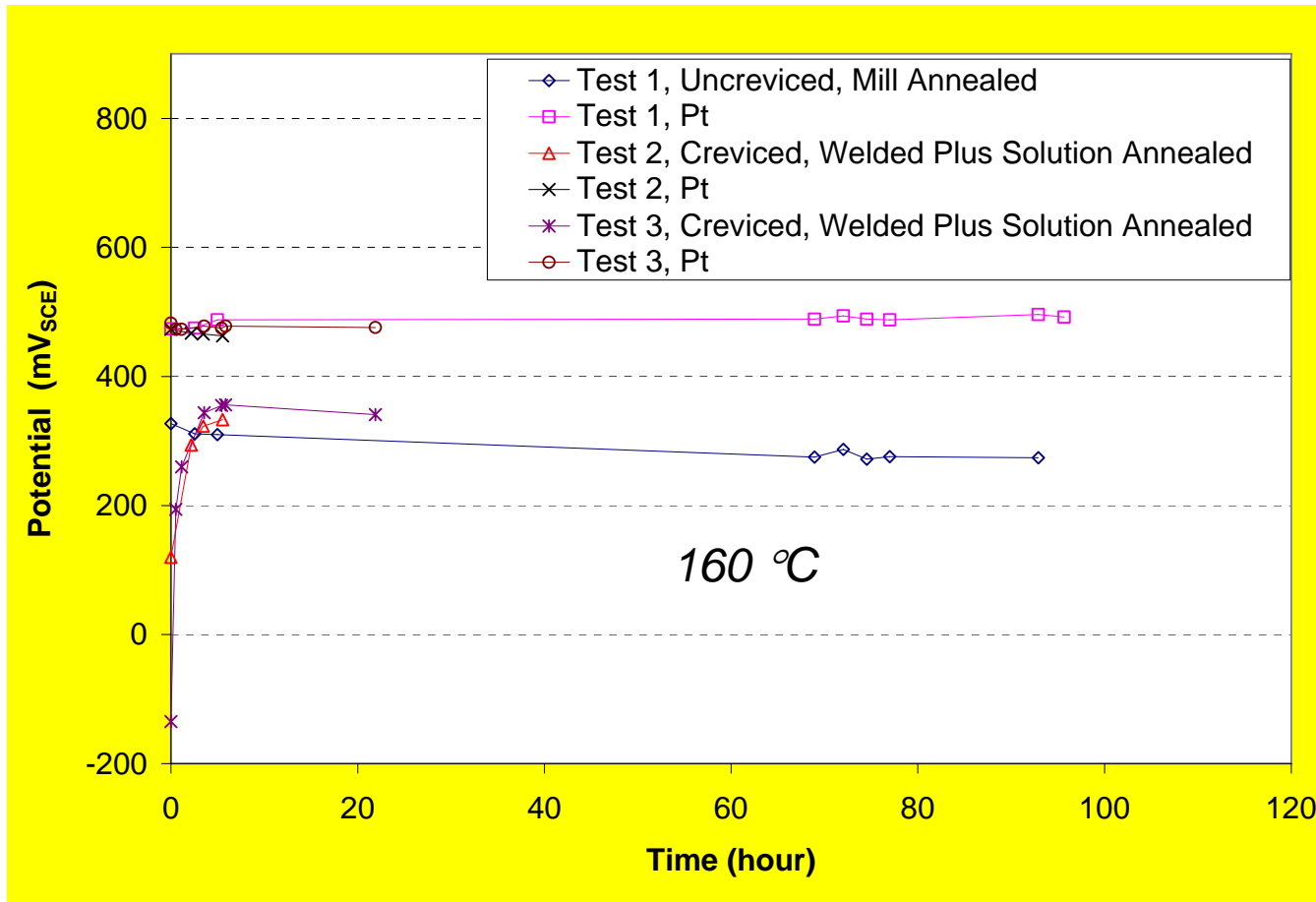
** DOE Presentation to NWTRB, Nov, 2005

*** BSC Report (ANL-EBS-MD-000049. Rev 02)

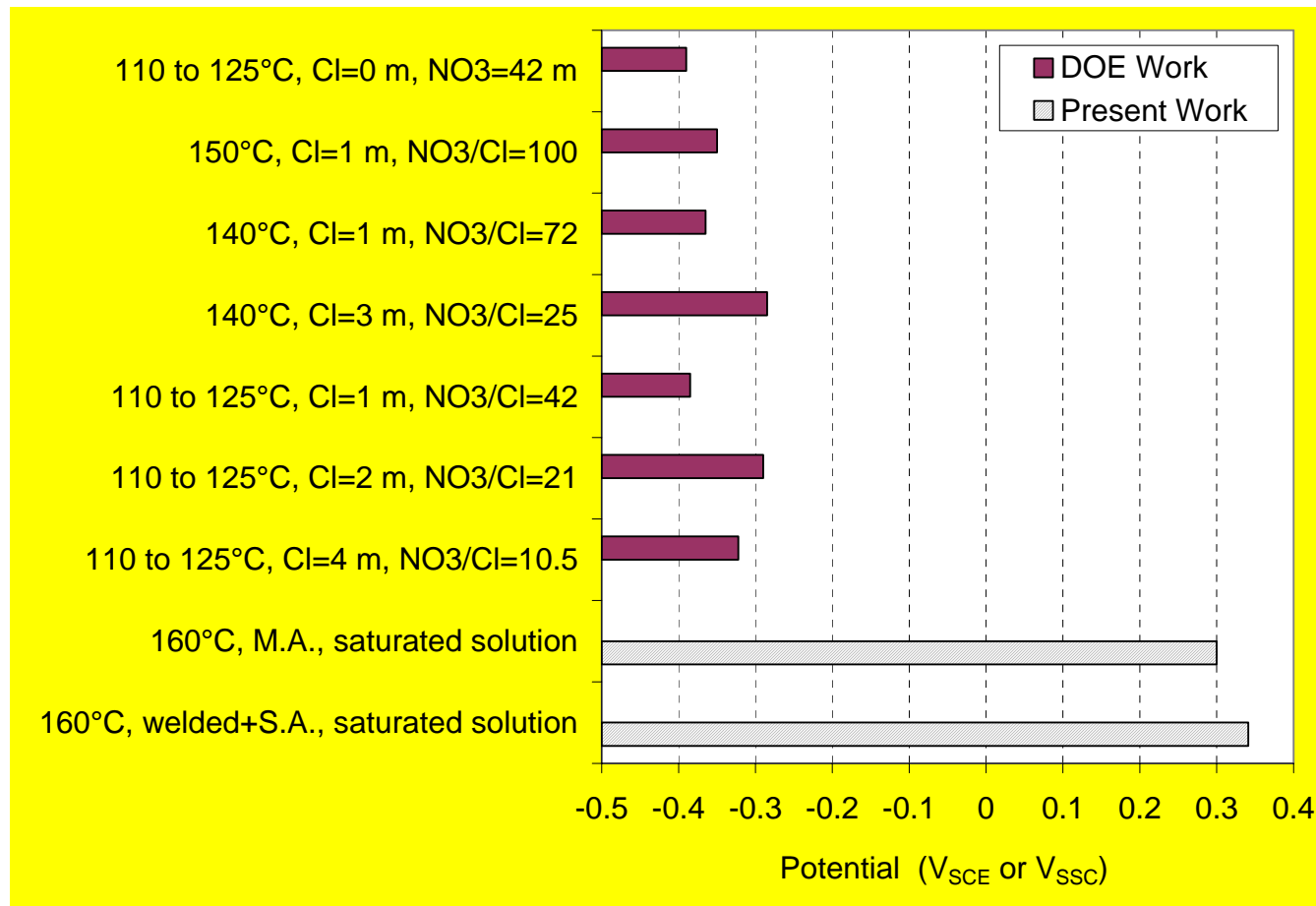
Experimental Setup for Corrosion Rate and Electrochemical Behavior Studies (ambient pressure, no deaeration)



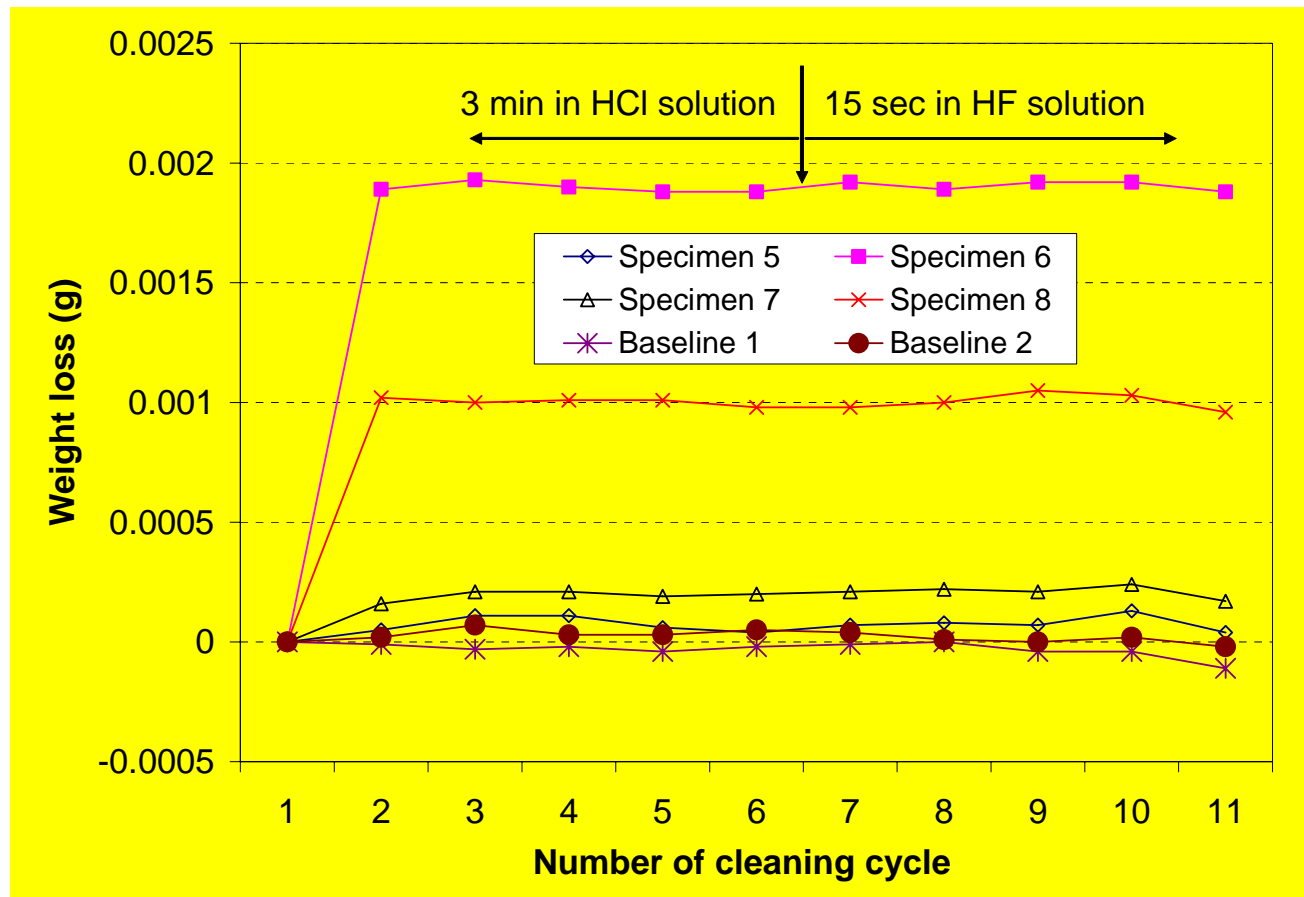
Corrosion Potential of Alloy 22 Is High and Oxidation-Reduction Potential at Pt Electrode Indicates an Oxidizing System



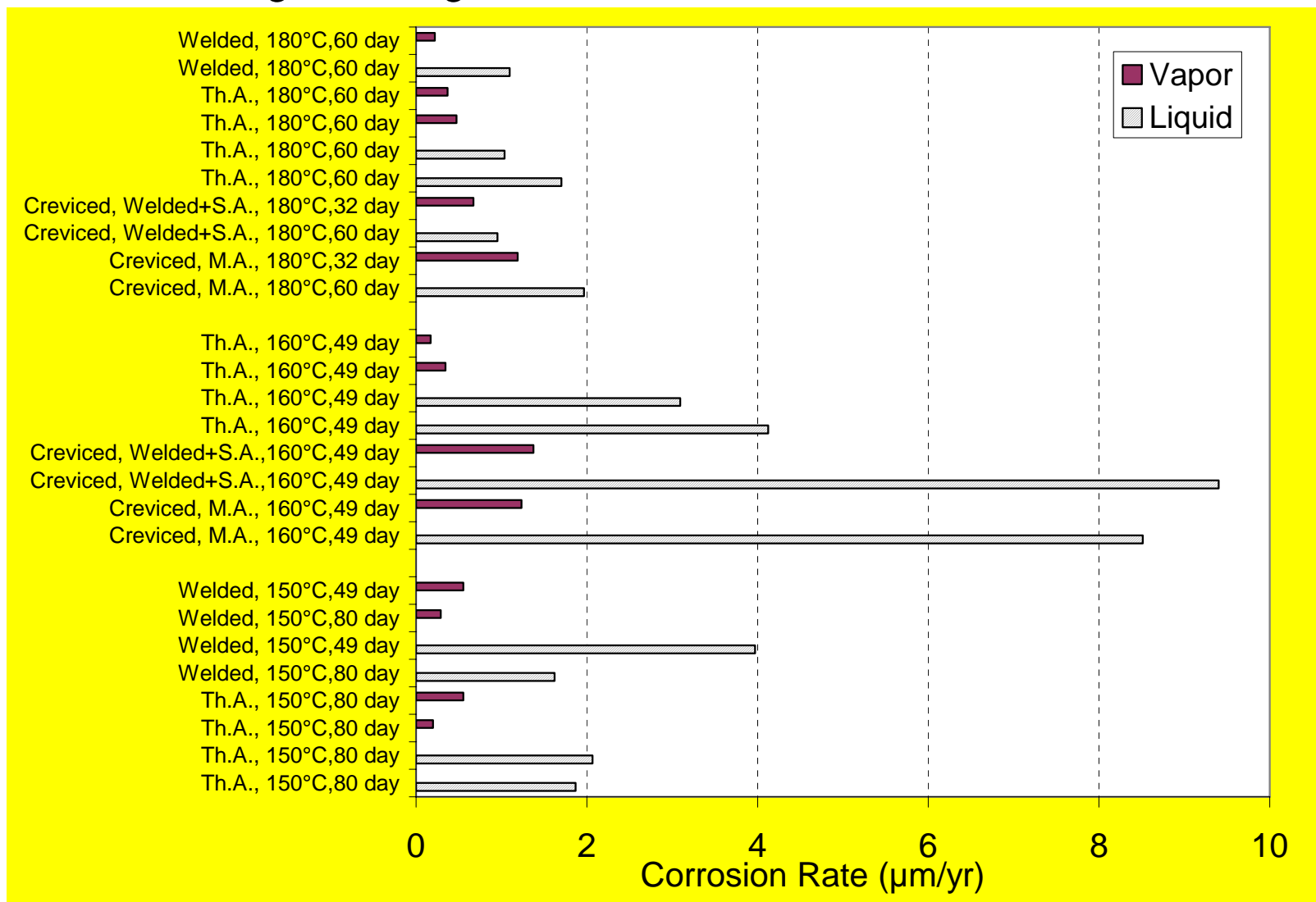
Measured Corrosion Potentials of Alloy 22 Are 600 mV Higher Than Those Measured in Deaerated Systems



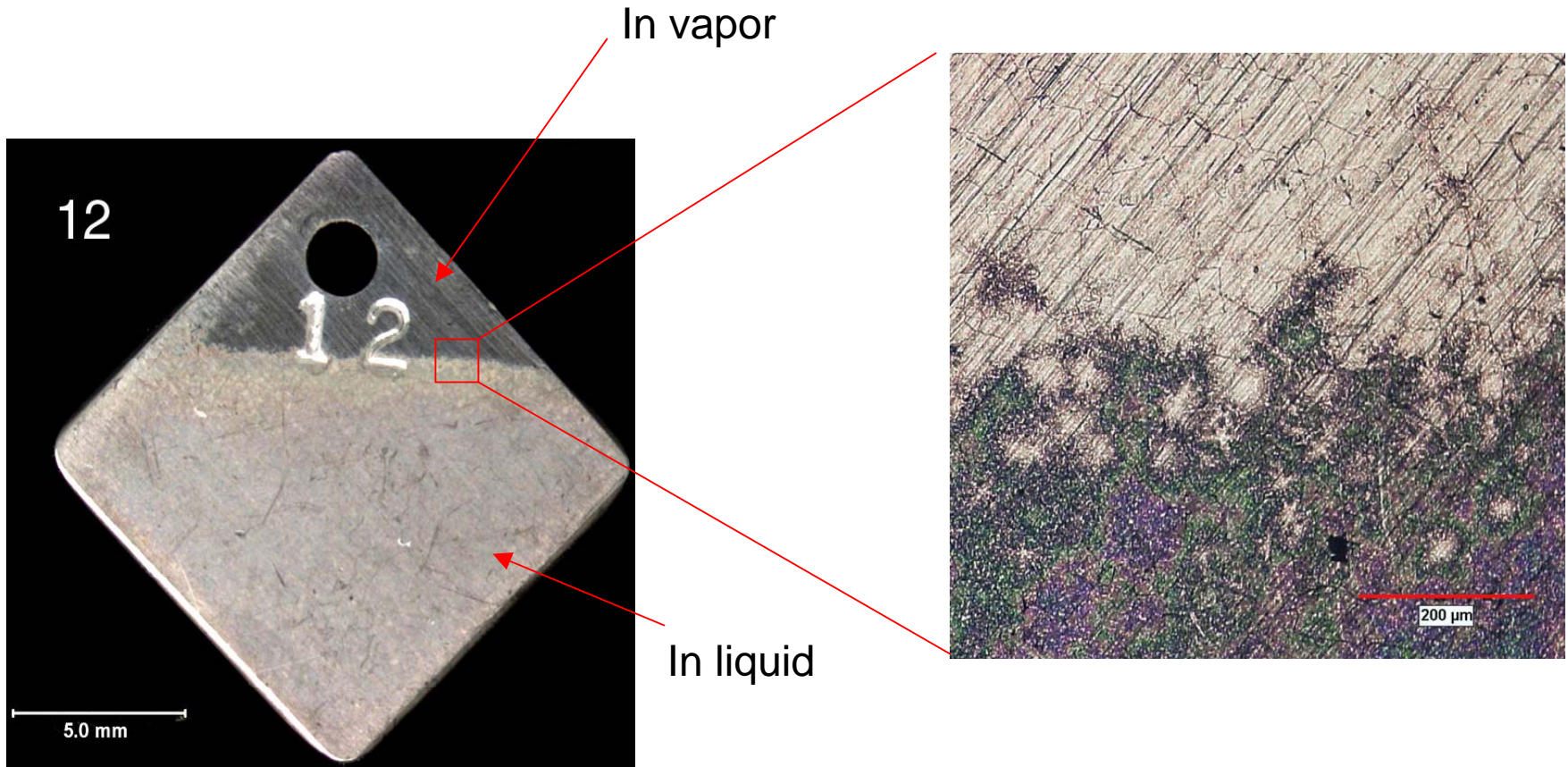
Weight Loss Measurement Cleaning Procedure: Weight after Third Cleaning Cycle in HCl Was Used in Weight Loss Calculation



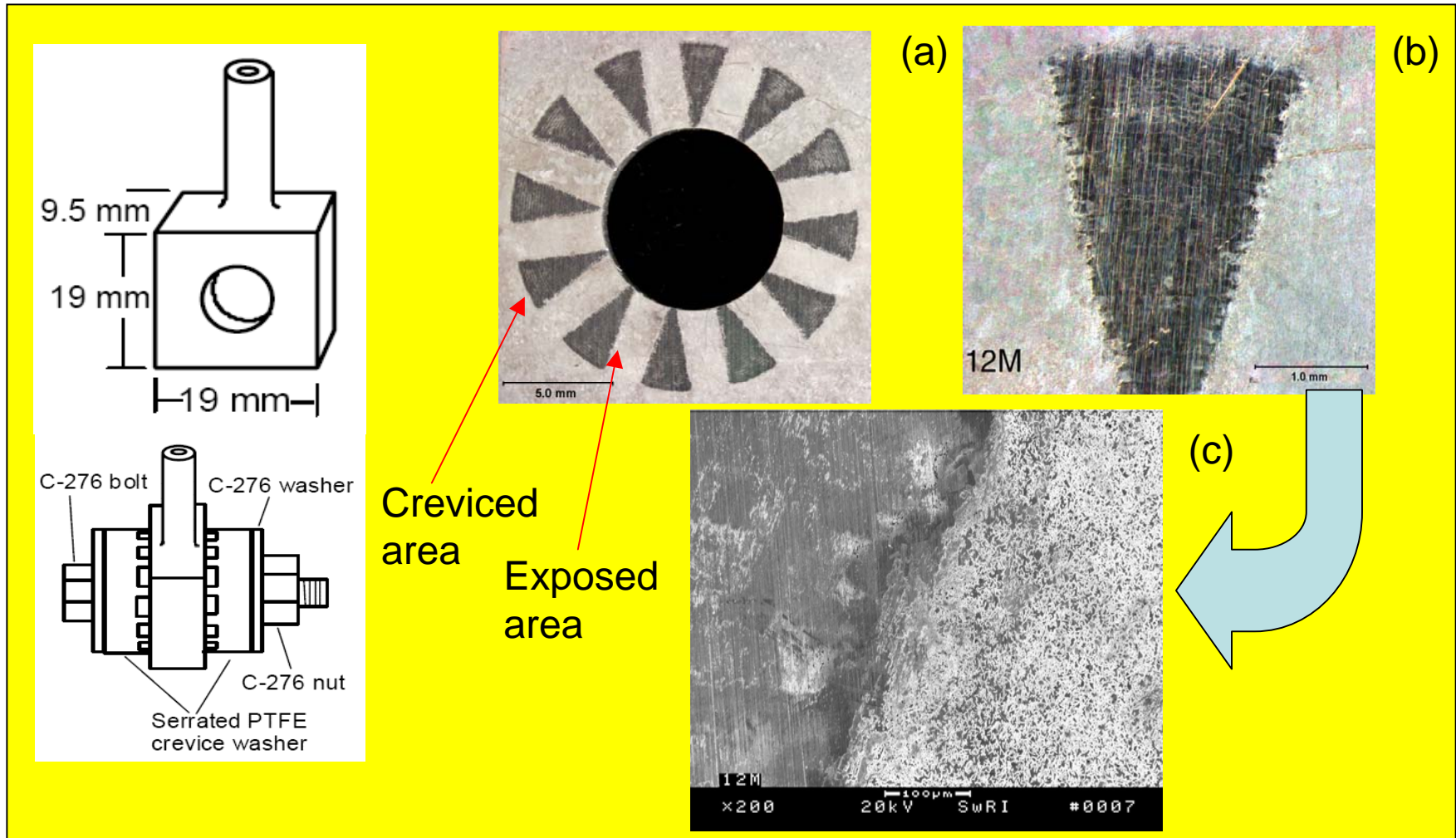
Corrosion Rates of Alloy 22 in NaCl-NaNO₃-KNO₃ Mixture



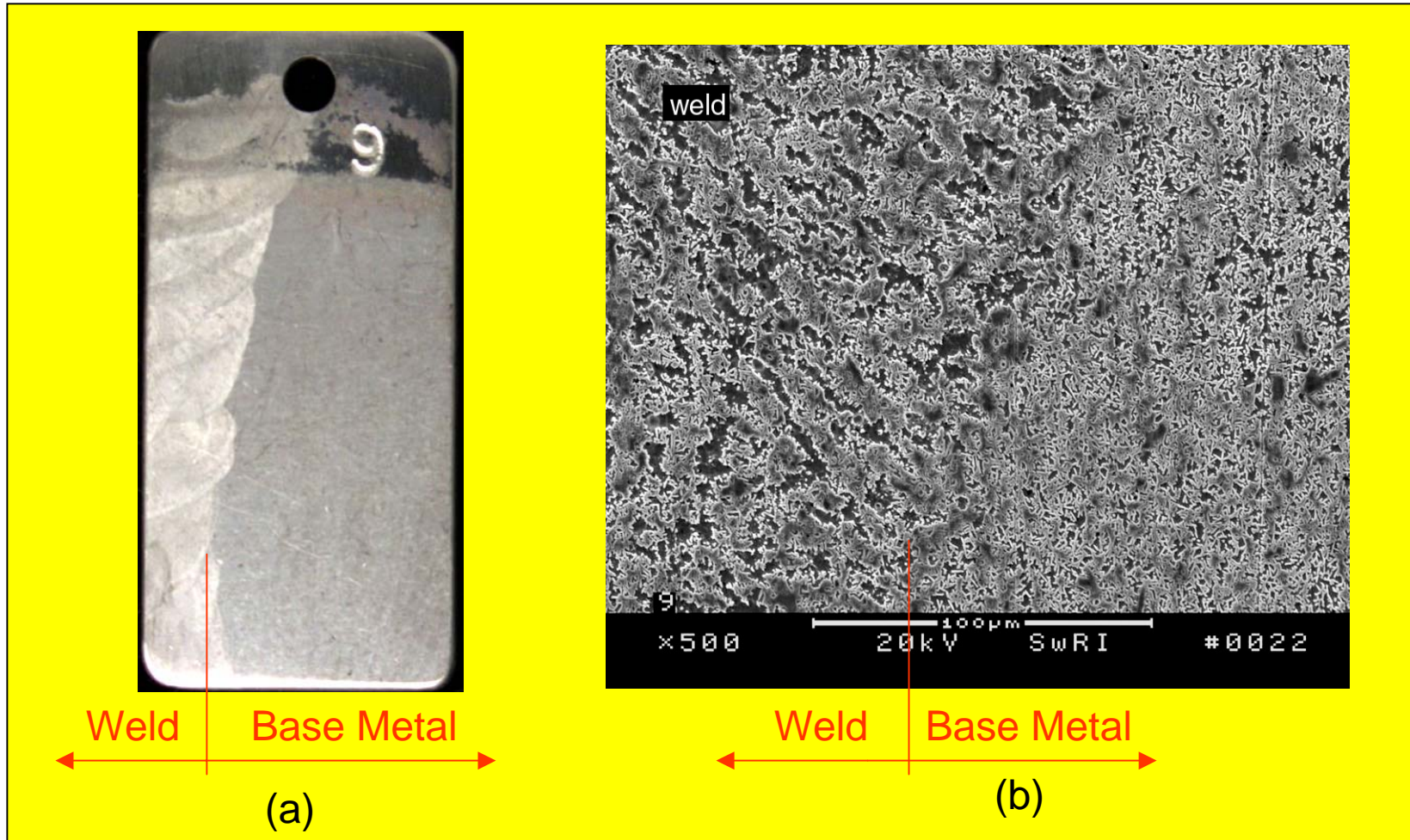
Alloy 22 Corroded More in Liquid Than in Vapor Phase



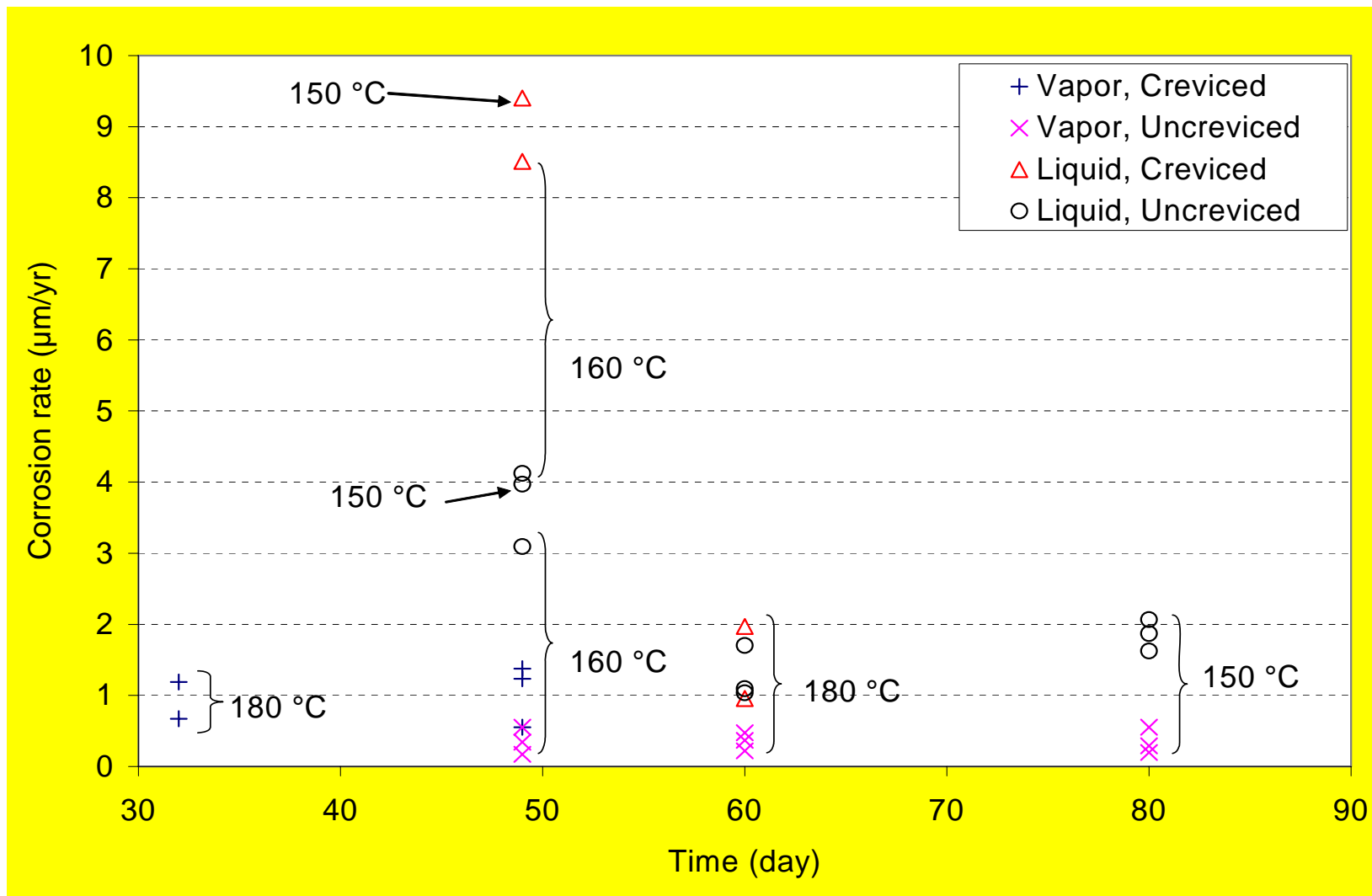
More Corrosion at Exposed Areas than Inside Creviced Areas for Alloy 22 Immersed in Liquid Phase under Open-Circuit Condition



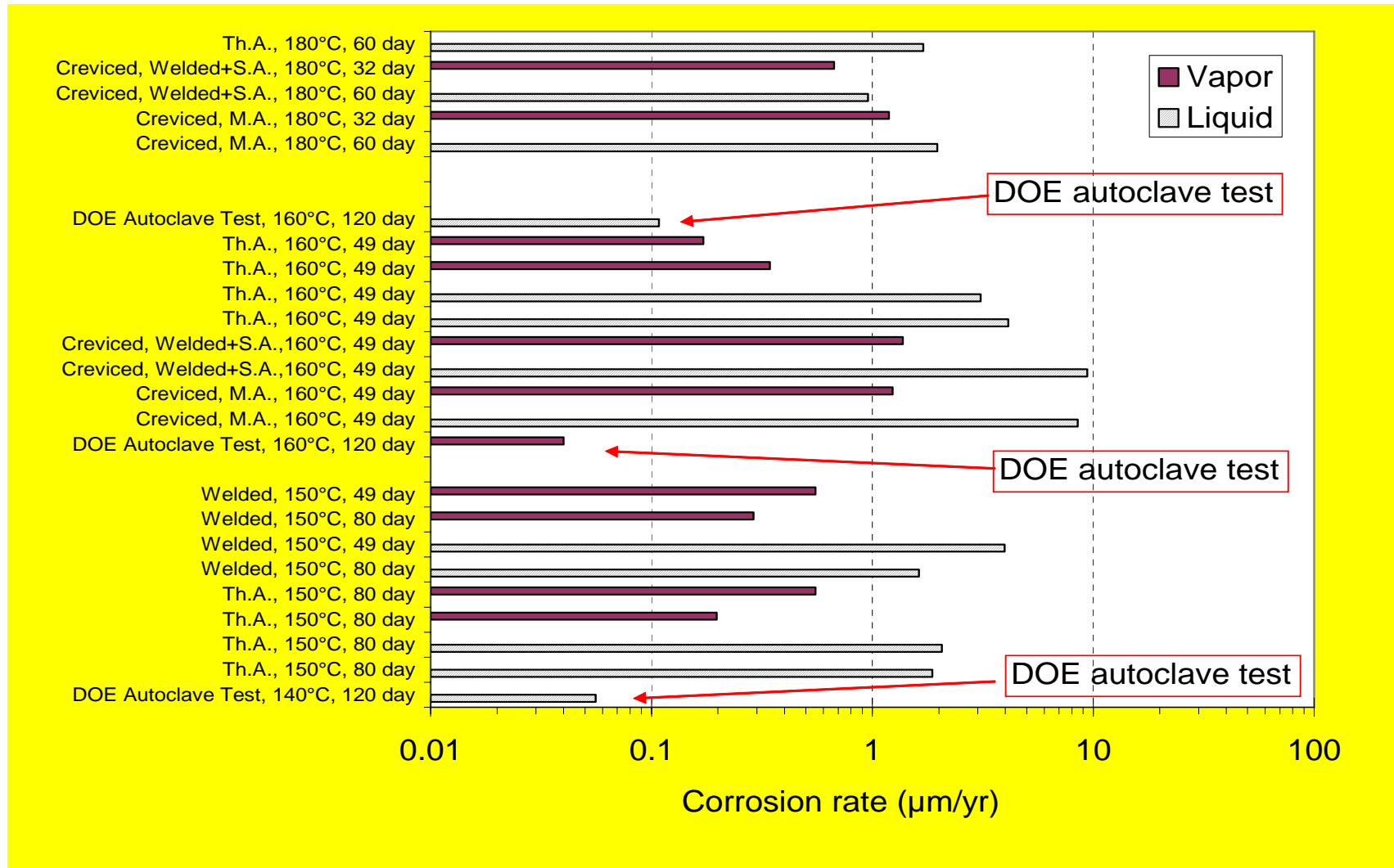
More Corrosion along Dendritic Structure in Welded Region



Corrosion Rates at Different Exposure Time and Temperatures



Corrosion Rates Measured in Presence of Air Are Higher than Those Measured in Autoclaves



Summary and Future Work

- Experiments were conducted in NaCl-NaNO₃-KNO₃ salt mixture under ambient pressure and without deaeration
- Corrosion potential was about 600 mV higher than those measured in deaerated system
- General corrosion was the major mode of attack. Corrosion rate was about 10 to 50 times higher than those measured in autoclaves
- Tests are ongoing for characterization of the evolution and stability of the salt mixture at elevated temperatures
- Longer-term tests are ongoing to verify:
 - General corrosion rates
 - Localized corrosion susceptibility

Acknowledgment

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- This work is an independent product of CNWRA and does not necessarily reflect the view or the regulatory position of the NRC.

BACKUP SLIDE

Polarization Behavior of Alloy 22 in Nitrate-Chloride Mixture at 160 °C

