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Environmental Effects on Stress Corrosion Cracking of Alloy 22

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Alloy 22 is the candidate material for the waste package outer container for permanent disposal of high-level radioactive waste at the potential repository in Yucca Mountain, Nevada. One of the possible degradation modes for the container is environmentally assisted cracking of Alloy 22. Slow strain rate tests revealed that bicarbonate and chloride ions, two common constituents of groundwater, act synergistically to promote transgranular stress corrosion cracking of mill-annealed Alloy 22. Chloride solutions capable of sustaining stress corrosion cracking of Alloy 22 require sufficient bicarbonate and carbonate concentrations and high corrosion potentials for transgranular crack initiation. However, high corrosion potentials can only be developed in low-pH solutions where bicarbonate and carbonate ions are not stable. An abstracted model taking into account the environmental and electrochemical conditions required for the stress cracking of Alloy 22 was developed based on the experimental results. Monte Carlo analyses indicate a low probability for the establishment of environmental conditions capable of sustaining stress corrosion cracking of Alloy 22.

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