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# Copper Corrosion in Bentonite/Saline Groundwater Solution: Effects of solution and bentonite chemistry

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**Abstract**

Copper corrosion has been studied in simulated groundwater with and without added bentonite clay using different electrochemical techniques. The corroded surfaces were characterized by SEM/EDS, Raman spectroscopy and Auger depth profiling. In both environments small amounts of sulphide (0.005 mM) control the early corrosion behaviour. Under aerated conditions an initially formed $Cu_2S$ film is rapidly converted to a non-protective layer of cuprite and corrosion proceeds with the deposition of an outer layer of atacamite. In the presence of bentonite corrosion proceeds slowly under $O_2$ transport control. No atacamite is observed and the Cu surface appears slightly pitted.

**Keywords:** Copper, bentonite, saline groundwater, electrochemical impedance spectroscopy

## 1. Introduction

Both the Scandinavian and Canadian high-level radioactive waste disposal programs propose to place spent nuclear fuel in tightly sealed copper canisters in a geologic repository backfilled with compacted bentonite clay [1,2]. By supplementing engineered barriers with naturally occurring materials, it is hoped to closely imitate nature [3]. Since the Cu container is the only absolute barrier to the release of radionuclides, its corrosion has been studied extensively [2, 3–14].

The initial rate of Cu corrosion will be determined by factors such as moisture, temperature, and the presence of aggressive groundwater species like chlorides, nitrates and sulphates [1]. In the longer term the corrosion process will evolve towards steady state at a rate depending on the corrosive environment (chemical composition, pH, resistivity), and the metallurgical properties of the container.

When exposed to humid air, Cu oxidizes to $Cu_2O$, which protects it from further corrosion [15]. However, in the presence of aggressive species, secondary corrosion processes occur. In the fields of atmospheric and archaeological corrosion the resulting film is referred to as a patina [16,17]. The structure

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