Corrosion Behavior of SKB Copper in KURT Environment

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1. Introduction

SKB (Svensk Kärnbränslehantering AB) has been conducting the corrosion evaluation of forged copper as for the corrosion resistant barrier of a disposal canister in early years [1]. KAERI has also been conducting long-term corrosion studies of cold spray coating copper at KURT since 2010 [2]. And recently KAERI obtained the forged and extruded copper of SKB, and tried to verify their corrosion behavior in the KURT environment. The purpose of the KURT corrosion test was to confirm the applicability of SKB copper in domestic disposal environment and to estimate the difference in corrosion resistance compared with the cold spray coating copper of KAERI. By the way, two vacant tests without bentonite buffer were added in the KURT corrosion test of cold spray coating copper and SKB forged copper.

In this paper, the corrosion experiment for SKB coppers at KURT in progress was introduced, and the first dismantling results of 6 month old specimens were reported. This experiment was started in July 2018, and planned to finish in July 2028.

2. Experiment

Test specimens were ChangSung cold sprayed coating Cu (purity 99.5%), SKB forged Cu (Purity 99.99%, Cast No.05-230-3-1), and SKB extruded Cu (Purity 99.99%, Cast No.O14). A test specimen (D 15.0 × t 1.0 mm) was inserted between two compact bentonite blocks (D 30.0 mm × t 10.0 mm), and then the combination was stored in a small corrosion cell allowing water permeation. Many cells were kept in environmental chambers at 70 ^{o}C at KURT, and fresh underground water was passing through the chamber continuously at 10~20 cc/min.

Two kinds of bentonite buffer were used in the experiment. One is Ca-type GJ bentonite and the other is Na-type Wyoming bentonite which were compacted to 1.6 g/cm^3 in dry density.

In vacant tests, test specimens were loosely wrapped with a porous paper towel (Yuhan Kimberly, KIMECH Science Wipers), and stored in the same corrosion cell.

3. Result

3.1 First Dismantling

The corrosion cells of 209 days old were dismantled in March 2019. The extracted specimens were shown in Fig. 1.

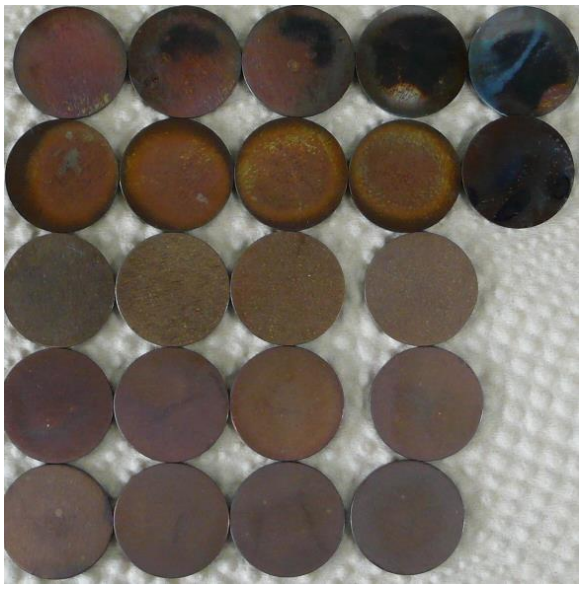

Fig. 1. The 209 days old test specimens after dismantling and surface cleaning (from top; Vacant-cold sprayed Cu, Vacant-SKB forged Cu, Ca bentonite-SKB forged Cu, Na bentonite-SKB forged Cu, Na bentonite-SKB extruded Cu).

3.2 Corrosion Depth

The corrosion depth was determined by weight loss measurement. Vacant specimens showed 2-3 fold higher corrosion depth than the specimens surrounded by compact bentonite blocks (Table 1).

Table 1. Corrosion depths of 209 days old-Cu specimens

Materials	Buffer	Avg.	Std. D.
CSC Cu	Vacant	0.707	0.132
SKB F-Cu		0.400	0.091
SKB-F-Cu	Ca-GJ	0.249	0.071
SKB-F-Cu	Na-Wy	0.225	0.011
SKB-E-Cu	Na-Wy	0.243	0.012

The main corrosion product was cuprite (Cu_2O) in all Cu specimens as a result of XRD analysis. And tenorite (CuO) was also found in vacant specimens unlike others.

4. Conclusion

High pure-SKB Cu specimens showed similar corrosion depth of around 0.2~0.3 ㎛ with KAERI cold sprayed coating Cu. The compact bentonite was very helpful for the corrosion resistance of copper in KURT underground condition.

ACKNOWLEDGEMENT

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