

Preparation of Anoxic Corrosion Test of Canister Materials in a Deep Borehole

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1. Introduction

It is very important to verify the corrosion behavior of a disposal canister in a regional deep geologic environment. KAERI launched long term corrosion test cells in Oct. 2010 at KURT site. The launched corrosion test is undergoing in oxic condition. Recently anoxic corrosion test is planned since it is presumed that the canister corrosion in the most of the disposal period occurs in anoxic condition.

Anoxic corrosion test in a borehole is progressing in GTS, Swiss as a name of 'MACOTE; MATERIAL CORROSION TEST'[1]. The KAERI anoxic corrosion test is recently planned in one of old exploration boreholes near KURT site like MACOTE.

2. Experiment

2.1 Borehole Selection

The borehole depth is only 10 m in the MACOTE since GTS is located in anoxic granitic rock bed. But the depth of a test borehole in this study will be around 300 m from ground. Several old exploration boreholes in KAERI site was studied, and then a borehole designated as YS-03 was selected since its Eh value was enough low (-247 mV) to be reductive to copper and closely located near security trail.

2.2 Borehole Conditioning

A single packer was installed at 250 m depth in YS-03, and the underground water below the packer has been extracted to about 9 liter every week through a H55 m long and ID15 mm Pipe line. The characteristics of extracted water from YS-03 were summarized in Table 1.

Table 1. Characteristics of YS-03 underground water

	Name	pH	EC, uS/cm	DO, mg/L
	Old(2004)	10.0	144	1.9
YS-03	5/23(2018)	9.36	140.6	0.14
	7/10(2018)	9.47	141.7	0.16
	8/24(2018)	9.39	128.7	0.15
	KURT Test	8.57	144.8	4.62

The oxygen concentration measured in 2018 is very lower, and the pH is higher than the old one. The YS-03 also showed clearly different water properties from the feed water supplied to the KURT corrosion test. As a result of ion concentration analysis, Cl^- is 2 ppm, SO_4^{2-} is 6 ppm, but the HCO_3^- is 36 ppm in the YS-03 underground water. It was certain that the YS-03 has been well isolated from the oxygen rich sub-surface water.

2.3 Corrosion Module Design

The YS-03 is 300 m deep and NX size (D76 mm) borehole. Some mud or debris by wall spallation may sink on the borehole bottom, so a rigid base support should be installed before the module installation. The corrosion module was designed in BX size (D60 mm) cylindrical container to fit in the NX size

borehole. Nine bentonite blocks of 10 mm thick is packed in the module, and 6 kinds of candidate metals (D15 mm, t1 mm) are inserted between the block layers as seen in Fig. 1. The test metals are to be cold sprayed coating Cu, compressed Cu, SKB forged Cu, Titanium, Stainless steel, and cast nodular iron. There are 10 μm pore metal filters at the inside top and bottom of the module for water flow-in but blocking of bentonite extrusion

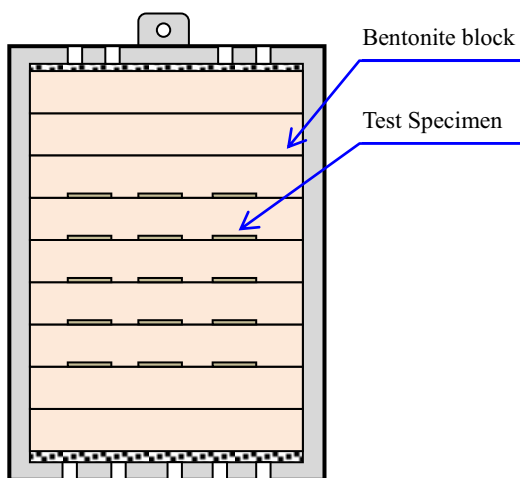


Fig. 1. Conceptual illustration of a corrosion module for a borehole corrosion test.

The emplacement of corrosion modules is quite troublesome because the lowering distance is 300 m, and its retrieval must be possible after long days. Several emplacement methods were considered as connection and disconnection method, single rotary wire connection, and respective cord connection for each module. Then the respective cord connection was chosen as an emplacement method because it is very reliable and less obstructive for the packer installation after the module emplacement.

3. Conclusion

The installation of corrosion module is planned in

2019 after several demonstration tests. And the module will be extracted after 1-2-3-4-7-10 years respectively. Actually, the extraction process is more important than the installation process because the extracted module should be kept not to contact with oxygen. Thus the design of a transportation bag for the carrying and a glove box for the dismantling of the module is necessary after the module launching in 2019.

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