Post-Project Survey of Sulfuric Acid-Resistant Anti-Corrosion Coating Method

(Research of FY 2017-2021)

1. Purpose

This report describes (a) a field study, post-project survey, of wastewater treatment facilities applying sulfuric acid-resistant anticorrosive coating methods and (b) a follow-up investigation of sulfuric acid-resistant mortar tentatively applied at the existing facilities. The research aims to improve the technology by identifying issues in the "Corrosion Control Guidelines for Sewerage Concrete Structures" (JS Corrosion Control Manual).

2. Investigation Contents

- **Post-project survey of sulfuric acid-resistant anti-corrosion coating method:** In 2017, a questionnaire survey was conducted for municipal WWTPs in Japan to know the status of anti-corrosion coating layers. After that, a field survey was conducted at 14 WWTPs with anti-corrosive coating layers of excessing ten years from FY2018 to 2021 to study the corrosive environment, such as corrosive environment indicators in liquid/gas phases and deterioration status of anti-corrosive layers, including adhesive stability and sulfide intrusion depth.
- **Follow-up investigation of sulfuric acid-resistant mortar:** The ten-year follow-up investigation was conducted for sulfuric acid-resistant mortar, experimentally applied at the existing facilities, for their deterioration status and corrosive environment. The follow-up research was completed in 2019.

3. Outcomes of This Year

Table 1: Summary of 2021 survey result

			WWTP #1	WWTP #2	WWTP #3	WWTP #4	WWTP #5
Target facilities			Primary settling tank	Reservoir for excess sludge	Primary settling tank	Gravity thickening tank	Grid chamber channel
Anti-corrosion coating layer							
	standards		D	D	C	D	C
	Materials		Epoxy resin	Epoxy resin	Vinyl ester resin	Epoxy resin	Epoxy resin
Anti-corrosion coating service life (year)			16	26	21	22	19
Corrosive environment survey							
	Liquid phase environment survey						
		Water temperature	℃	19	21.5	28	29.5	22
		pH		8.7	6.9	7	12.5	4.6
		Redox potential	mV	-83	217	105	-209	14
		Dissolve oxygen concentration	mg/L	0.67	0.47	0.09	1.33	0.33
	Gas phase environment survey						
		Hydrogen sulfide gas (avg.)	ppm	6.4	0	1.8	28.5	0
		Hydrogen sulfide gas (max.)	ppm	36	0	14	150	2
		Carbon dioxide	ppm	300	300	300	1200	300
		Anti-corrosion coating surface pH	ppm	3	7	8	6	7
Deterioration status survey							
	Field survey						
		Adhesion strength	N/mm	0.42	1.11	1.21	0.99	1.52
		Anti-corrosion thickness	mm	1.03	0.83	1.63	0.6	0.73
		Concrete neutralization depth	mm	0	0.5	0	0	0.5
	Physical property test						
		Sulfur intrusion depth	mm	0.053	0.006	0.046	0.023	0.187
		Sulfur intrusion depth ratio	%	5.15	0.72	2.82	3.83	25.62

This year's survey targeted five WWTPs that have applied an anti-corrosion coating layer of type C or D standards from the application type lining method, lasting more than ten years. Table 1 shows the survey results for their corrosive environments and status.

The "JS Corrosion Control Manual" sets the standard of adhesion strength at a field survey after application at 1.5N/mm2. Four facilities had less than

1.5N/mm2 adhesion strength, describing a reduction in adhesion with concrete.

All facilities had less sulfur penetration depth than the quality standard for each method in the Manual (Class C: 0.2 mm or less, Class D: 0.1 mm or less).

On the other hand, two facilities had the ratio of sulfur penetration depth to corrosion protection thickness exceeding the quality standards (Class C: 10% or less, Class D: 5% or less).

However, the maximum sulfur penetration depth was approximately 26%, indicating that the isolation against sulfide intrusion has worked even after a long service period.

4. Summary of the Entire Research Period

As a conclusion of the whole study period, the sulfuric acid-resistant anti-corrosion coating method is considered to maintain its isolation against sulfuric acid as a primary function after the standard ten-year service period.

On the other hand, maintaining and improving the adhesive performance of an anti-corrosion coating layer for a longer service life is an issue because concrete's integrity has been reduced.

Additionally, sulfuric acid-resistant mortar showed no surface degradation and cross-section damage after a standard service life of 10 years.

Keywords: **Anti-corrosion coating layer, Hydrogen sulfide, Sulfide penetration depth, Adhesive strength**