

Post-Project Survey of Sulfate Resistant Anti-corrosion Coating Methods

(Research of FY 2017-2021)

1. Purpose

In this survey, existing wastewater treatment facilities applied sulfate resistant anti-corrosion coating methods are investigated for their deterioration status caused by sulfuric acid. The investigation aims to define the relationship between the actual condition of the corrosion environment and the deteriorating conditions of anti-corrosion coating layers after their application. JS published "Corrosion Control Guidelines for Sewerage Concrete Structures" (2nd revision, 2012.) The purpose of this study is to find some issues on the survey, design and quality management of the guideline and contribute to the improvement of anti-corrosive technology.

2. Past research

In 2017, a questionnaire survey was made to municipal WWTPs all over the country to know the corrosion environment and the deterioration condition of anti-corrosive coating layers caused by sulfuric acid.

3. Outcomes of this year

Table 1. Inspection items


Test items		Subjects
Environmental testing		
Corrosive environment indicator in liquid phase		Sulfide generation status • Water temperature, pH, Oxidation-reduction potential(ORP)
Corrosive environment indicator in gas phase		Hydrogen sulfide gas generation status • Concentration of hydrogen sulfide gas • Carbon dioxide concentration
Anti-corrosive coating surface		Generation status of sulfuric acid: Surface pH
Field survey		
Visual observation for surface abnormality		Visual inspection, measurement, record • Swelling, crack, exfoliation • Softening, embrittlement, wear, discoloration, whitening, etc.
Adhesion test		Strength test of coating layer adhesion • Measure by using BRI model tension tester
Physical property testing		
Tensile testing		Tensile strength of coating layer: JIS K 7164
Bending test		Bending strength of coating layer: JIS K 7017
Barcol hardness test		Surface hardness of coating layer: JIS K 7060
Thickness measurement		Measure the thickness of sampled anti-corrosive coating layer with micro meter
Invasion depth of sulfur		Invasion depth of sulfate ion: Electron probe micro analyzer
Neutralization depth		Neutralization depth of concrete: JIS A 1152

(1) Researchers investigated three WWTPs applied sulfate resistant anti-corrosion coating methods. As table 1 shows, the investigation included the corrosion environment survey, field survey, and physical property testing to verify the

deterioration conditions of anti-corrosive coating layers and frame concrete. Figure 1 is one of the results of the inspection made at the place applied sulfate resistant anti-corrosion coating methods. The applied facility is a thickened sludge receiving tank, which average has 370ppm concentration of hydrogen sulfide gas. The gas concentration is equivalent to the corrosion environment category 1 of the above guideline. The anti-corrosion coating layer which has been applied for 13 years has a sulfur invasion depth of about 20-100 μ m. This represents the anti-corrosion coating layer mostly keeps the isolation capability which is one of the basic requirements. However, because the core sample taken from frame concrete showed had a sulfur invasion of 9 mm depth, it suggested that the deterioration of the coating layer might have allowed hydrogen sulfide gas invade to the inside.

On the other hand, adhesion strength with concrete was 0.3N/mm² on average, which critically degraded compared to the initial performance. All test samples had fractures of their primer parts. These outcomes suggested that the anti-corrosion coating method might have technical issues, that is an aging degradation on its adhesion stability.

(2) The follow-up survey was conducted on the test application of “the Mortar lining method” which is in the nine year after application.



Test items	Test result (13 years after application)	Quality standard* ¹ (initial performance)
Appearance of the coating	Swelling and exfoliation are observed	No wrinkle, unevenness, exfoliation, or crack
Adhesive property	Average 0.3 N/mm ²	Normal conditions: 1.5N/mm ² and over wet conditions: 1.2N/mm ² and over
Invasion depth of sulfur	27-114μm	5% and 100μm or less* ² than designed thickness when immersed in 10%H ₂ SO ₄ solution for 120 days

*1. Class D coating type lining method (source: JS corrosion control manual)

*2. Designed thickness of the test site is 3 mm and 150μm

Figure 1. Inspection results on degradation of sulfate resistant anti-corrosive methods

3. Future plan

The investigation on the environment and degradation of the anti-corrosion coating layer will continue in wastewater treatment facilities in the next year. Besides, the next year is the last year of the follow-up survey on the test application of the Mortar lining method.

Keywords: Anti-corrosion coating layer, Degradation/Deterioration, Adhesive property, Depth of sulfur invasion