Establishment of Corrosion Control Technology by Organic Acid/Carbonic Acid

(Research of FY 2017-2021)

1. Purpose

Recently, wastewater facilities have been concerned about anti-corrosion coating layer's degradation by organic acid and concrete deterioration by carbonic acid. But, there are little data on their actual situation.

This study aims to collect data on the decline of anti-corrosion coating layers caused by organic acid and carbonic acid in wastewater facilities and establish a measurement technology.

2. Outcomes of This Year

(1) Field survey for concrete degradation by carbonic acid

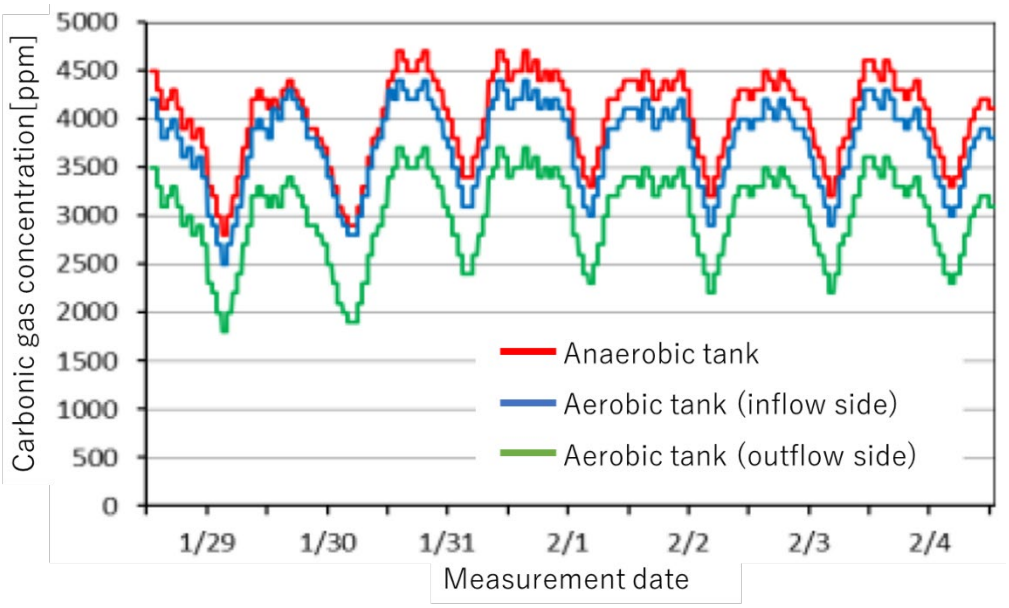
Table 1. Investigation items

Gas phase	• Carbonic gas concentration • Neutralization depth • Visual inspection, etc.
Liquid phase	• Erosive free carbon dioxide concentration • Carbonic acid concentration • pH • Alkalinity • Neutralization depth • Visual inspection, etc.
Others	• Temperature, humidity • Water temperature • ORP • Facilities' operation status (hearing survey)

As table 1 shows, the field survey targeted reaction tanks of two wastewater treatment plants to investigate degradation environments such as carbonic acid concentration and degradation stage of progress such as neutralization depth.

- Highly-concentrated carbonic acid gas exists in the gas phase. As figure 1 describes, the investigation verified the concentration varied significantly depending on the facilities' operation procedures, etc.

Figure 1. Measurement results of carbonic gas concentration at WWTP A



- The liquid phase partly showed an elution of concrete surface and aggregate exposure, which presumed the degradation by erosive free carbon dioxide.
- It was verified the anaerobic tanks had no neutralization on their liquid phase. On the other hand, in the aerobic tanks, their neutralization tended to progress faster at the shallow layer than the deep layer (table 2.)

(2) Field survey for the degradation of anti-corrosion coating layer by organic acid

At two WWTPs, specimens including wastewater, sewage sludge, thickener effluent, and scums were taken to analyze pH, alkaline degree, and volatile organic acid. This analysis aims to know the generation condition of organic acid and its concentration levels.

The investigation resulted in thickened sludge storage tanks, and scum pits had especially high-concentrated volatile organic acid.

(3) Investigation on the anti-corrosion coating layers' organic acid-resistant performance

Researchers conducted acid immersion experiments on the multiple anti-corrosion coating layer materials with or without the organic acid-resistant capability to compare physical property changes, including hardness and bending strength, and immersion depth of organic acid (table 3.)

- It was verified that organic acid-resistant resin has fewer effects from acetic acid regarding weight, form changes, and physical changes in addition to the appearance changes than standard resin with no organic acid-resistant.
- The researchers measured the penetration depth of organic acid using the alkaline marking method*. The measurement demonstrated that standard resin showed acetic acid penetration in all test conditions. On the other hand, it demonstrated organic acid-resistant resin restrained acetic acid penetration (Figure 2)

*Masatoshi Kubouchi, Abuduhailili Zulihuamer, Natsuki Tanimoto, Yoshihiko Arao, *Evaluation Method for the Organic Acid Penetration Depth into Epoxy Lining Materials Using Alkali Pre-treatment*, The 55th Annual Technical Conference on Sewerage,2018, pp.866-868

Table 2. Measurement results of neutralization depth on the liquid phase in WWTP A

(Unit: mm)

Investigation spot		Station 1	Station 2	Station 3	Average
Anaerobic	Deep	1.0	1.0	1.0	1.0
Aerobic (inflow side)	Shallow	10.8	11.0	10.5	10.8
	Deep	9.8	6.3	8.8	8.3
Aerobic (outflow side)	Shallow	9.5	11.3	9.3	10.0
	Deep	9.0	9.3	10.8	9.7

Table 3: Test items and conditions

Items	Test conditions
Anti-corrosion coating materials	Epoxy resin • Two types of standard resin with no organic-acid resistant • Two types of resin with organic-acid resistant
Acetic acid solution concentration	Underwater(0%), 5%, 10%
Temperature	**23℃±2℃**, 30℃±2℃
Days of immersion	**60 days**

Note: Test conditions that quality standards of organic-acid resistant defined at JS Anti-corrosion Manual are described in bold.

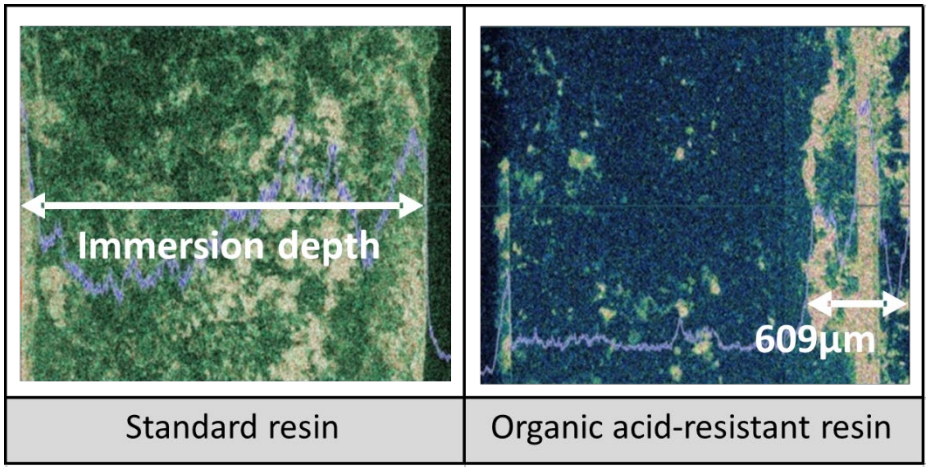


Figure 2. Immersion depths of organic acid (10% acetic acid at 30°C)

3. Future Schedule

The field survey will continue for the environments and conditions of deterioration at municipal WWTPs. Knowledge accumulation will develop the prevention measures for the decline caused by organic or carbonic acids.

Keywords: **Organic acid, Carbonic Acid, Anti-corrosion coating layer, Concrete Degradation/Deterioration**