Research on resin concrete conveyance facilities under sewer conditions

Year of Research	2007～2011	

(Purpose)

Sulfuric acid corrosion of sewer conveyance facilities caused by H_2S gas generation has recently attracted attention, and the corrosion of sewer pipes has caused serious accidents such as sinking subsidence of roads. It is difficult to detect corroded facilities at an early stage, because of the difficulty of continuously monitoring facilities.

To respond to the above circumstances, conveyance facilities predicted to be corroded should be made of acid-resistant materials instead of reinforced concrete. Resin concrete is one acid-resistant material with the composition shown in Table 1. Sewerage pipes and manholes made of resin concrete are gradually spreading owing to their high acid resistance performance, strength, and surface smoothness. But insufficient application criteria for resin concrete results in it being improperly applied and handled.

The purpose of this research is to clarify properties of resin concrete, evaluate its economic advantages, and compile a technical manual of application criteria.

(Results)

(1) Long term acid-resistance test

Three tests which assess the change of strength, mass, and appearance of resin concrete have been carried out for 4 years.

The first is a laboratory test, immersing the test piece in 5% sulfuric acid solution at 20, 30, 45, and 60℃, the second is a hot spring test, immersing the test piece in hot spring water of about 40℃ and pH1.5, and the third is an exposure test at 3 sewerage facilities.

Table 1 An example of composition of resin concrete

Materials		Mass %
Unsaturated polyester resin		11.0
Coarse aggregate	Crushed rock 2.5-5mm	25.5
Fine aggregate	Silica sand (coarse)	25.5
	Silica sand (fine)	23.8
Filling material	Fly ash	14.2

Test results after one year are as follows; . . .changes of mass, size, and shape of resin concrete were observed, except for color change of the test piece from dark gray to pale gray. Strength degradation of resin concrete has not been confirmed at this time.

In the case of cement concrete tested for comparison, test pieces were severely corroded by each test. Mass decrease was 14% in the hot spring test, and 17% to 44% in the exposure test at H2S gas concentration of 150ppm.

(2) Clarifying application criteria and compiling precautions for the construction phase

We have surveyed the results of past adoption of resin concrete for sewer facilities, and have clarified the sewer conditions necessary for application of resin concrete.

1) Questionnaire survey of current situation

Ninety-five municipalities among the 124 that responded adopted resin concrete pipes or manholes. Reasons for adoption were classified as “corrosion resistance” 54%, “high strength” 20%, and “smoothness of surface” 19%.

2) Survey of existing facilities made of resin concrete

Resin concrete manholes operated for 10~11 years at the sewage treatment plant were surveyed, and no defects were observed in any of the manholes.

3) Compiling precautions for the design and construction phases

Through an investigation of the actual state of resin concrete facilities, we have compiled precautions concerning handling, transportation, storage of resin concrete products, and on-site machining operations.

(3) Economic evaluation of resin concrete facilities

1) Comparison of construction cost with that of the jacking method

Resin concrete pipes have superior hydraulic properties and are designed with a roughness coefficient of 0.010, so resin concrete pipes are available as a pipe one size smaller than reinforced concrete pipes at the same gradient. And resin concrete pipes can be designed for a gentler gradient than reinforced concrete pipes with the same diameter.

Consequently, the construction cost including pipe price of resin concrete pipes is estimated to be almost the same or less than the cost of reinforced concrete pipes.

2) Comparison of construction cost with that of the open cut method

Resin concrete pipes have smaller outer diameters and are lighter than reinforced concrete pipes, so their construction cost is lower than that of reinforced concrete pipes.

Construction cost including pipe price for resin concrete pipes is generally higher than the cost of PVC and reinforced concrete pipes because resin concrete pipes cost more.

(Schedule)

(1) Continuation of the long term acid-resistance test

(2) Continuation of the survey of existing resin concrete facilities

(3) Application test of sludge incinerator ash as resin concrete material

Collaborators: ASO RESICON Co.,Ltd., NIPPON CHUTETUKAN K.K.,
and Japan Institute of Wastewater Engineering Technology.
Contact : Osamu Matsushima, Shizuo Yoshikawa, and Masaki Matsuo of the Second Research Department

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