

## Research on resin concrete conveyance facilities under sewer conditions

Year of Research

2006~2010

### (Purpose)

Sulfuric acid corrosions of sewage facilities caused by H<sub>2</sub>S gas have recently attracted attention, and serious accident such as sinking subsidence of a road are occasionally happened by the corrosion of sewer pipes. It is difficult to detect corroded sewage facilities at an early stage, because of the difficulty of continuous monitoring for the facilities.

From the viewpoint of the above circumstances, the sewage facilities which will be predicted to be corroded should be made of acid-resistant materials instead of reinforced concrete. Resin concrete (REC) is one of the acid-resistant materials, and its normal composition is shown in Table 1. REC pipes and manholes for sewerage are increasing owing to its high performance on its acid-resistance, strength, surface smoothness. But the insufficient applicable manuals on REC would often result in improper application and handling of the REC products.

The purpose of this study is to clarify properties of REC, evaluate economical advantages, and complete a technical manual which provides applicable criteria.

### (Results)

#### (1) Long term acid-resistant test of REC

The following three tests for 4 years were planned to assess the change of REC's performance and have been carrying out.

Test #1 is a laboratory test which immerse the test piece in 5% sulfuric acid solution at 20,30,45, and 60°C, test #2 is a hot spring test which immerse the test piece in hot spring water of about 40°C and pH1.5, and test #3 is an exposure test at 3 sewage treatment plants.

Test results after 2 years are summarized as follows;

Any change of mass, size, and shape of REC test piece was not observed. Color of test piece has changed from dark gray to pale gray. Strength of REC has slightly reduced only in the immersion test at higher temperature (45 and 60°C in test #1, and test #2). We considered that this phenomenon might be caused by the hydrolysis of resin in hot water.

#### (2) Clarifying applicable criteria and completing considerations at construction phase

We have surveyed past adoption results of REC products for sewage facilities, and have clarified the applicable condition sewer of REC.

##### 1) Current situation survey by questionnaire

We had questioned to 175 municipality (47 prefectures, 17 designated cities, 111cities), and 124 municipality (71%) responded.

Number of municipality adopted REC pipes or manholes was 95, and reason of adoption was classified as "corrosion resistance" 54%, "high strength" 20%, "smoothness of surface" 19%.

##### 2) Survey on existing facilities made of REC

Some REC manholes operated for 11 years at the sewage treatment plant were surveyed, and every surveyed manholes were sound and defect-free.

##### 3) Completing considerations in design and construction phase

Through an investigation on the actual situation of REC products, we have compiled some attention on handling, transportation, and storage of resin concrete products, and on-site machining operations to resin concrete products.

Table 1 An example of normal composition of REC

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

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(3) Economical evaluation of REC products

1) Comparison of construction cost at a Jacking Method

REC pipes have superior hydraulic property, and are designed as their roughness coefficient of 0.010, so REC pipes are available the pipe of one size smaller than Hume pipes at the same gradient condition. And at the same inner diameter of pipes, REC pipes are able to design of smaller gradient than Hume pipes. Consequently, construction cost included pipe price for REC pipes is estimated almost same or less of the cost for Hume pipes.

2) Applicable condition of REC products

Application of REC products will be recommended to the following construction site.

- site required acid-resistance, wear-resistance, and freezing-thawing-resistance
- site limited on gradient of conduit and pipe diameter by existing underground installation
- site not utilized large-sized construction machine

(4) Examination on utilization of sludge incinerator ash to REC products

We found that sludge incinerator ash can be used as a part of filling material (25% of fly ash) at the resin amount of 11%, and the mechanical property of test piece and trially produced pipes made of REC contained the incinerator ash is almost equivalent to REC of normal composition without incinerator ash.

(5) Results

Technical manual : “Resin concrete pipes and manholes for sewerage”

**(Schedule)**

Continuance of the long term acid-resistant test

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Key words

Resin concrete, Hydrogen sulfide, Corrosion, Acid-resistance