

## Research on FRPM pipe

Period

1998.9-1999.3

### ( Purpose )

For excellent water tightness, corrosion-resistant, and workability, etc., the reinforced plastic multiunit pipe (of following, FRPM tube ) was first to be used as the sewerage, now is widely utilized for agricultural drainage and so on, and has the extension of about 3000km of the sewerage, since it is produced in 1970.

In Kobe City, the FRPM pipe was adopted about 20 year ago, and FRPM pipe of about 3km was laid in the Port island process zone from 1978 to 1979. The Han-Shin Awaji Earthquake disaster which the north of Awaji Island was the hypocenter of the earthquake happened in January, 1995, brought the destruction damage to the center of the Kobe City, especially, the great damage was also brought to the pipe line facilities due to the liquefaction in the Port island district. The damage situation of FRPM pipes was investigated right after the earthquake, and the crack of pipes was not found. However, it was confirmed that the crack occurred at the pipe top, when the inside of pipes was investigated in 1997.

And, the FRPM pipe of Misasa trunk line was laid for about 1.8km in Tenjingawa River watershed of Tottori Prefecture in 1985. Afterwards, the abnormality was discovered in the inside of pipe when carried out the maintenance in the service area, and as a result of the investigation in 1994, the crack was confirmed at top of about 70% of laid FRPM pipes.

In this cooperative research, it was aimed to investigate the cause of generation of the crack of FRPM pipe and examines the reconstruction method by constructing Kobe City, Tottori Prefecture and this Organization from such history.

### ( Result )

#### 1. Resources acquisition and cases investigation of another city

The situation investigations on the past damage cases (2 cities) of another cities and FRPM pipes used at present (3 cities) were carried out as a reference of this research. In the city where damage of pipes occurred in past, the causes of damage have been assumed to be the Generation of the hydrogen sulfide gas and pH1-2 strong acidity condition. Moreover, the abnormality could not be observed in service FRPM pipes where there was no generation of the hydrogen sulfide gas, etc. at present.

#### 2. Investigation content

In order to investigate the cause, the field study was carried out on the position where the crack arose that hydrogen sulfide gas concentration in pipe line, electron micrograph of the crack part, analysis by the X-ray of sulfur constituent permeated in FRPM pipe, sanitary sewage, ph measurements in pipe material, and deflections of pipe line, etc. were investigated. In these results, that there was sulfur constituent permeated in FRPM pipe material, and the hydrogen sulfide gas happened was able to be confirmed.

#### 3. Port island process zone of Kobe City

Main damage cause in Port island process zone in the Kobe City was estimated as following.

Differential settlement was generated in the Han-Shin Awaji Earthquake disaster with the liquefaction of the ground. For this, the counter-gradient occurred in pipe line, the sludge piled up in pipe line, and the hydrogen sulfide gas was generated. And, the overload beyond design load also seemed to affect the FRPM pipe from damage situation of another kind pipe after the earthquake disaster.

From such situation, it is estimated that the strong acidity environment by the sedimentation of sludge due to differential settlement and the load which exceed design load by Han-Shin Awaji Earthquake were the causes of generating crack of FRPM pipe of pipe lines. By combined these causes, the adverse effect was given to the pipe, and the lowering of strength was caused and it seemed to promote the early occurrence of crack.

#### 4. Misasa trunk line of Tenjingawa River watershed in Tottori Prefecture.

Initial cause of crack of the FRPM pipe in the Misasa trunk line was estimated as following.

By the fluctuations of the groundwater, etc., the looseness arose at sand part of the pipe base, and top and

bottom of pipe became high stress state. Solubility hydrogen sulfide which was included in the sanitary sewage of Misasa trunk line was radiated as hydrogen sulfide gas to the vapor phase division in waterfall chute and step junction division, and the sulfuric acid was finally formed in the pipe top. The interaction of the above mentioned adverse conditions caused the rupture of the glass fiber, and this seems to be the cause of crack initiation.

#### 5. Reconstruction method

For the case of two superscriptions, it was judged to rebuild the entire interval, since the sulfur constituent was detected by the analysis of core of the interval where there was not the crack happened, the safety as sewerage pipe can not be ensured. Still, the sheath plumber method was proposed on the reconstruction method as a result of considering workability and economical efficiency, etc..

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