Study of earthquake and tsunami countermeasure technologies to prevent sewage treatment system damage

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1. Outline of damage to sewage systems by the Great East Japan Earthquake

The Great East Japan Earthquake severely damaged many sewage facilities extending from the Tohoku region to the Kanto Region. In particular, treatment plants and pumping stations along the Pacific Coast were severely damaged by tsunami, and along the shore of Tokyo Bay and in the downstream region of the Tone River in the Kanto, liquefaction throughout the region obstructed the sewage conveyance functions of sewage pipeline facilities (Fig. 1).

Figure 1. View of Damaged Sewage Facilities

2. Questionnaire survey

The National Institute for Land and Infrastructure Management carried out a questionnaire survey of local governments in the damaged region (effective response rate: 69%) in order to clarify the causes of damage to sewage treatment plants and sewage pipeline facilities caused by the Great East Japan Earthquake. Figure 2 shows the percentages of damage by cause to individual facilities (categorized as 23 facilities) in sewage treatment plants and to pipeline facilities.

Among sewage treatment plants, 54% were damaged by the tsunami, followed by 41% by the earthquake motion, and 4% by liquefaction. Of the damaged pipes, 90% were damaged by liquefaction, and most of these, at 66%, were damaged by liquefaction of the pipe backfill, which has been a problem since the Niigata Chuetsu Earthquake. And unlike past earthquakes, liquefaction of surrounding ground caused 25% of the damage.

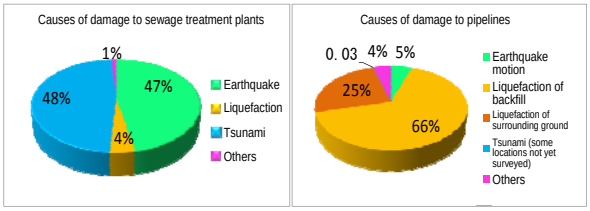

Figure 2. Causes of Damage to Sewage Facilities

3. Problems at sewage facilities caused by the Great East Japan Earthquake

Sewage treatment plants in cities along the coastline are natural flow type which must discharge their water into public bodies of water, so the treatment plants are inevitably constructed relatively close to the ocean. Therefore, this tsunami caused extensive damage: the destruction of building structures by its powerful wave force and damage to electrical and mechanical by submersion. But present aseismic design guidelines do not mention tsunami countermeasures, so concepts of sewage facility design considering tsunami-resistance countermeasures based on an early clarification of the state of damage will be compiled and released in the future. And among sewage pipelines, many without earthquake resistance countermeasures were damaged, including those where liquefaction of the surrounding ground caused soil to flow in from the lateral pipes so that the pipes were plugged with soil, obstructing their sewage conveyance function, although the damage to the pipes themselves was minor. Therefore, it is expected that aseismic design guidelines will be expanded in order to deal with damaged backfill by encouraging conventional liquefaction countermeasures, and for facilities damaged by liquefaction of the surrounding ground, liquefaction countermeasures will be taken on lateral pipes, which have not been the object of past measures.

4. Utilizing the results

Concepts of sewage facility design considering tsunami-resistance countermeasures and concepts of the expansion of liquefaction countermeasures will be

announced by the Sewage System Earthquake/ Tsunami Countermeasure Technology Study Committee, and later will be reflected in aseismic countermeasure guidelines based on a study by the Sewage Facility Aseismic Countermeasure Guideline Revision Committee.

[Reference]
Fifth Report by the Sewage System Earthquake/Tsunami Countermeasure Technology Study Committee