

## Exhaust facility in combined sewer storage tunnel in Otsu City

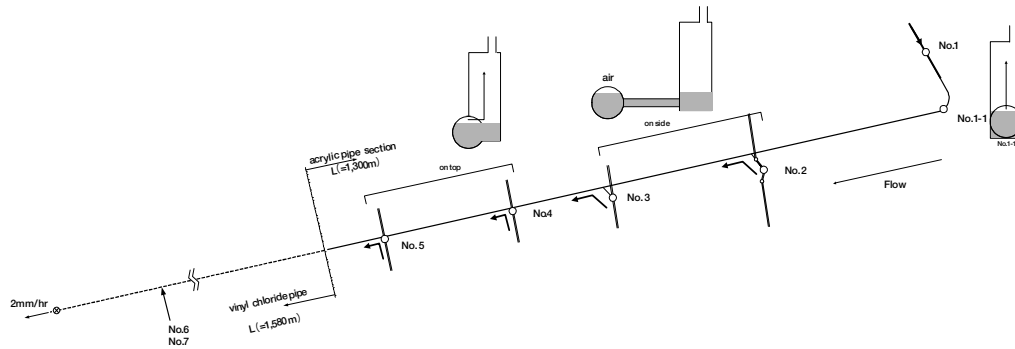
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### (Purpose)

Sewerage Bureau of Otsu City is working on a sewerage plan by large scale storage tunnels for overflow water of combined sewers. This study was conducted to make clear the behaviors of air-liquid mixture in conduit during storage process, and to propose hydraulic structures of exhaust facilities in combined sewer storage systems.



**Figure-1** general view of the hydraulic model

### (Result)

#### 1. Test of storage system

We performed the hydraulic tests for one of two trunks, named by OJIYAMA-OTSU, that is 2.8m in diameter, 2,880m in length, and 11,400m<sup>3</sup> in volume. This conduit would be located at deep underground, and connected to near-surface sewer systems by deep shafts.

Air-liquid mixture in long pipe with some shafts during storage process is focused on.

##### (1) Test Procedure

Flow process which involve a free surface are controlled primarily by gravitational, pressure, and inertial forces. Dynamic similarity of these forces requires that the Froude number be the same in model and prototype. We adopted model scale 1:14 in horizontal, 1:18 in vertical considered with Froude similarity and some restrictions of facilities, such as water supply capacity.

##### (2) Contents

- a. Effect of exhaust pipe on storage trunk
- b. Effect of Orifice in storage trunk

#### 2. Facility for exhausting air

Focused on air entrainment and transport in deep dropshaft and storage pipe, that would be induced blowing due to compressive air and decreasing of flow capacity.

To decrease these phenomena, we examined the structures of exhaust facility, and developed new type of exhaust facility.

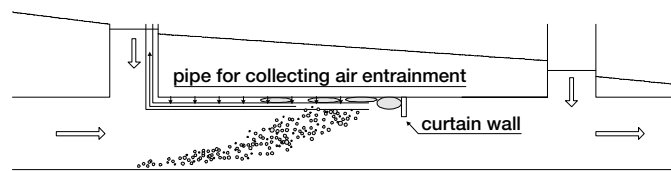
##### (1) Test Procedure

Froude model underestimates the ratio of air entrainment compared with prototype. So we adopted geometrical large scale 1:5.7 for model tests.

##### (2) Contents

New type of exhaust facility consists of horizontal pipe with small holes to collect entrained air in storage tunnels, vertical pipe in shaft for exhausting air, and curtain wall on the end of horizontal pipe.

- a. Fundamental structure like diameters of horizontal pipe ,position and scale of curtain
- b. Detail structure of horizontal pipe



**Figure-2 schematic of air transport in storage pipe**

(Summary)

We developed new facility for exhaust air, and procedure to controlling occurrence of open surge by Orifice in storage pipe.

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key words

Sewerage plan, Combined sewer storage tunnel, Hydraulic model test