

## Research on a technique for measurement of Rainfall-derived infiltration and inflow in sewage lines using a RFID tags

Whole term

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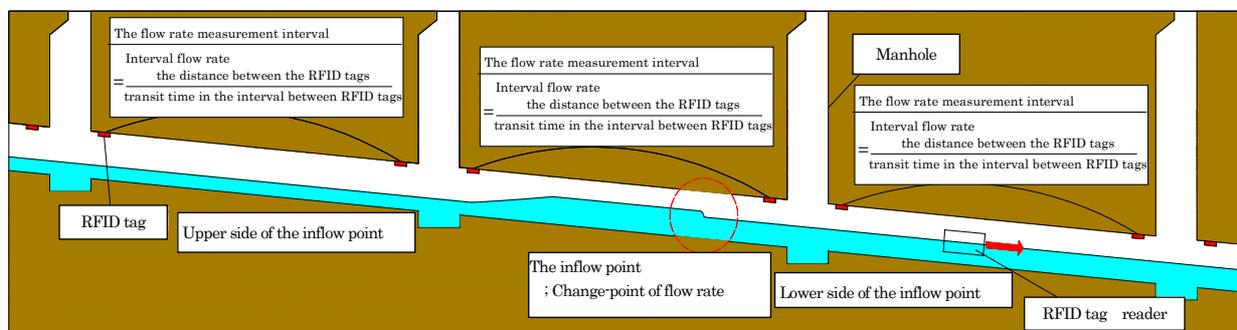
### (Purpose)

In a separate sewage system, flow explosions that occur at sewage plants and pump stations due to heavy rain become a big problem, and it is treated as Rainfall-derived infiltration and inflow. Some of the causes of Rainfall-derived infiltration and inflow are errors at drainpipe-work, and damages to pipes, manholes, and joint connections. The problem by heavy rain causes not only significant impacts for sewage facilities, but also many problems such as cost escalation and inland water overflowing. So, drastic countermeasure, simple and quick procedure to determine the area where Rainfall-derived infiltration and inflow happen, is required.

A current typical measuring method is an analysis based on flow rate measured at sewage plants, pump stations, and at manholes where measurement devices (a flowmeter, a current meter, and a water-level gauge) are installed in newly. Even if these measured data shown unusual values, it only shows that the trouble points are at upper water of these measurement devices. In that case, more detailed research is necessary, and it will require tremendous amounts of money and time.

To solve these problems, we have developed a technique of RFID; Radio Frequency Identification, which can measure the change of the flows of consecutive and multiple points in short time, by floating down the measurement devices through sewage lines. Fig.1 shows this technique process. First, float down a RFID tag reader. Then the tag reader wirelessly accesses RFID tag at each manhole, and record the location data and transit time. Using the data, the flow rate between each manhole is estimated. In various weathers (fine, rain, fine night, etc.), if the measured flow rate is different from the theoretical flow rate, it is highly possible that there is inflow within the interval.

In this research, the purposes are to examine efficiency and applicability of the flow measurement devices with RFID developed as prototypes, and to confirm feasibility of the devices in actual sewage lines.



**Fig 1** the principle of the inflow investigation with

### (Results)

From a basic performance experiment and a communication performance experiment in empty hume pipeline, the devices shows sufficient waterproof property, stability, and communication performance (communication distance, device speed measurement). Therefore, it is confirmed that the devices can measure flow rate if the pipe is between 300-600mm in diameter. A model experiment, in model line with actual flowing water, shows that measurement techniques and devices, developed in this research, have feasibility in actual sewage lines.

For actual use, there are following problems and it is necessary to expand the measurement range. Also, there are possibilities that some unexpected problems occur in actual sewage line circumstances. So more experiments are necessary.

#### (1) Device specification problems

The device is 100 mm thick. So it is not possible to flow down, if the water is not more than 30% level, in case of 300mm diameter pipe. Actually, the water can be less than about 20%. There is the need to develop the devises of 60mm thick.

(2) Software problems

The research of this time, was mainly about hardware side. To achieve of the purpose; “specify the area of inflow”, we have to study not only hardware side but also software side (the analytical method by the data from the measurement devices). One of the future study subjects is to perform the experiment related about software side, to judge the procedure can confirm the area of inflow or not.

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Key words

RFID, RFID tag, RFID tag reader, Rainfall-derived infiltration and inflow