Studies on Seal break prevention in Siphonic drainage system with 20m piping

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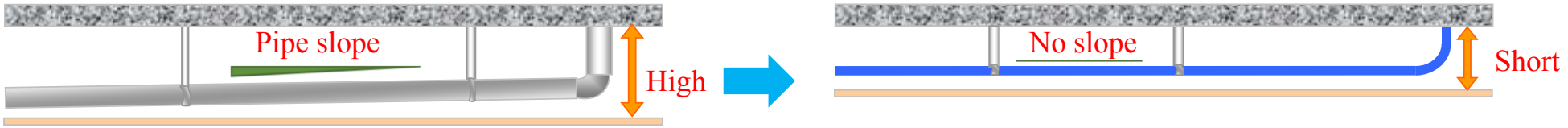
1. Introduction

The Siphonege drainage system

In ***the Conventional Drainage system*** based on slope,
a large piping space is required.
Particularly, when water use places are isolated in buildings
such as plants where the floor planning, piping space tends to be large.

Siphonic drainage system operates using siphonage generated by filled flow in the piping as a driving force.
It is expected to grow in popularity as it can be installed with small diameter pipes and no slope, which greatly increases flexibility in piping design.
While water seal trap has been playing an important role in preventing drainage gas from entering indoors,
not much consideration has been given to the retention of seal water in trap.



The Conventional Drainage system

The Siphonic Drainage system

1. Introduction -Purpose & Approach-

Purpose

In this study we conducted experiments to examine the validity of backflow prevention apparatuses of odor in the siphonic drainage system. We attached S traps and air admittance valves at the inflow part, and observed the effects of flow characteristics and S trap on seal loss when the positions of the valves were varied, and self-sealing traps were attached.

Approach

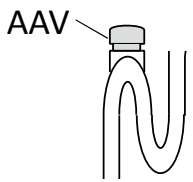
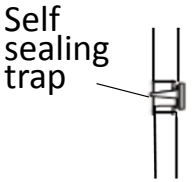
Experiments on Flow Characteristics in U-PVC pipes with horizontal length of 20 m

CASE 1

With S trap + Air admittance valve(AAV) at the inflow part

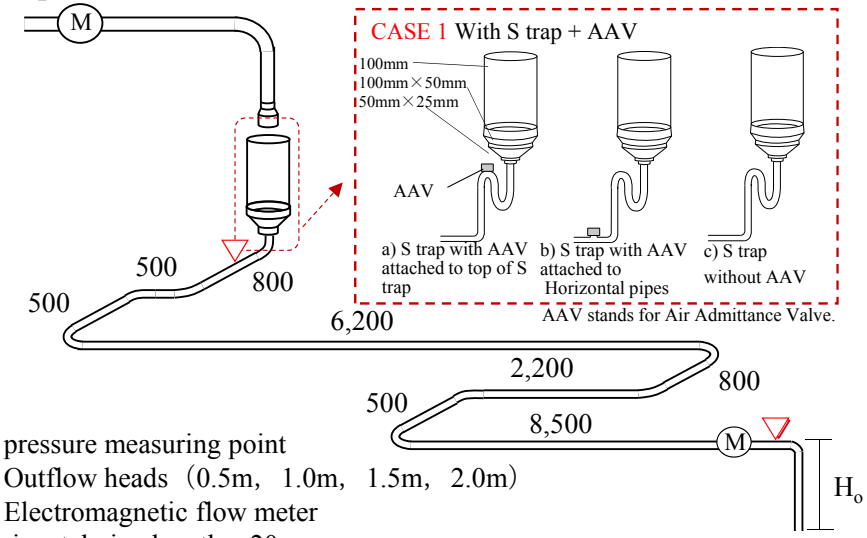
CASE 2

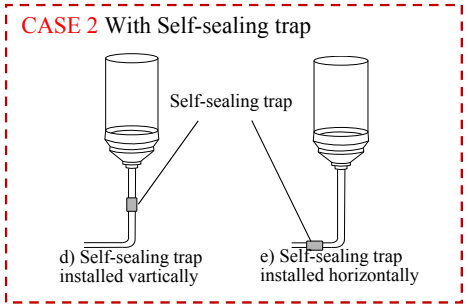
With Self-sealing trap at the inflow part

CASE1 S trap + Air admittance valve	CASE2 Self sealing trap
	

2. Method -Experimental devices & condition -

i) Experimental devices





▽ : pressure measuring point
H_o : Outflow heads（0.5m, 1.0m, 1.5m, 2.0m）
Ⓜ : Electromagnetic flow meter
Horizontal pipe length : 20m
Number of bend : 9

Unit [mm]

ii) Constructional elements

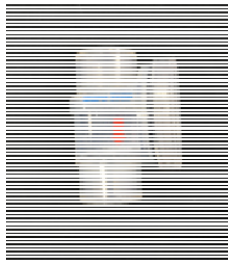
CASE 1

■S trap

■Air admittance valve

CASE 2

■Self-sealing trap



Experimental apparatus

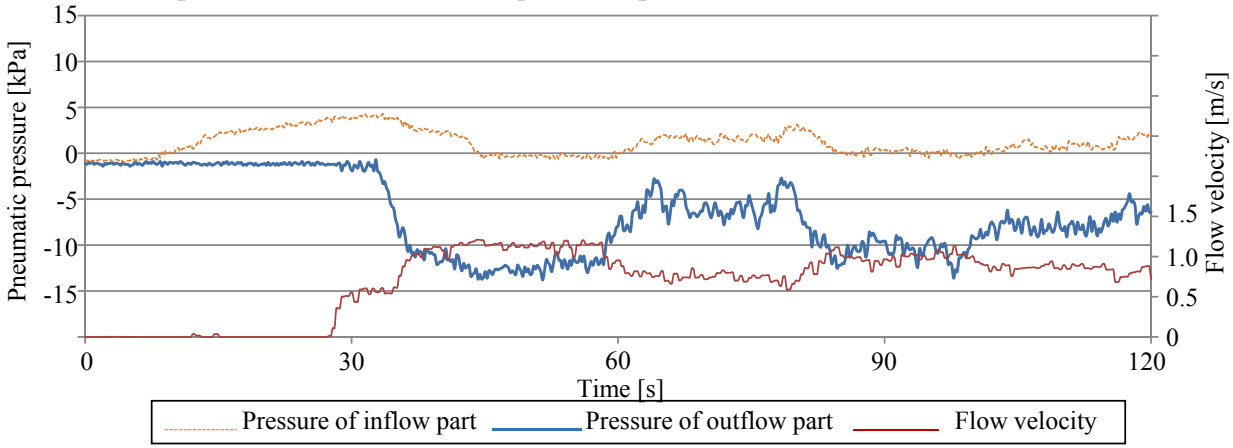
Experimental condition

Diameter [mm]	Pattern of inflow part	Outflow head [m]	Supply flow rate [L/min]
20 ・ 25	(a) ~ (e)	0.5 ・ 1.0 ・ 1.5 ・ 2.0	10 ・ 12 ・ 18 ・ 24 ・ 30 ・ 36

※Common condition　Material : U-PVC,　Horizontal pipe length : 20m

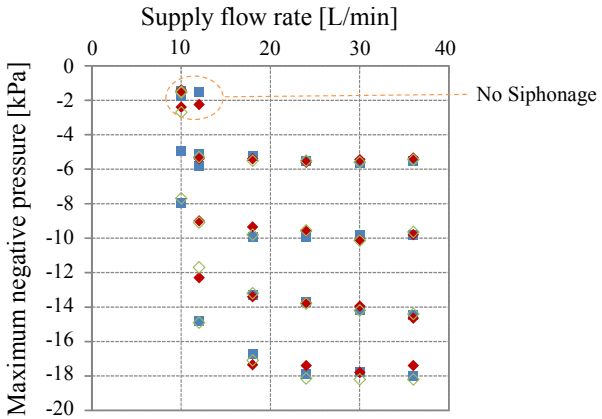
3. Result -CASE 1-

a) S trap with AAV attached to top of S trap

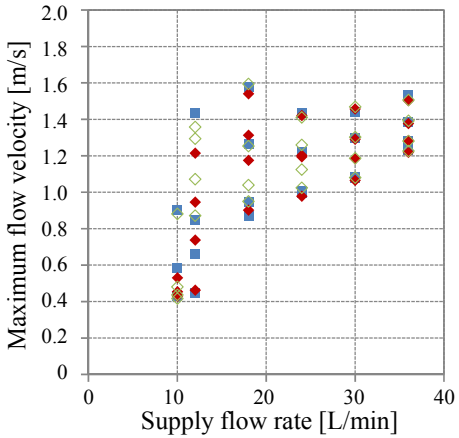


Fluctuations of pressures in drain and discharge flow velocity

(the condition of inflow part with S traps, φ25 mm pipes, outflow heads of 1.5 m, supply flow rate 24 L/min.)



Maximum siphonic negative pressure (φ25 mm pipes)



Maximum flow velocity (φ25 mm pipes)

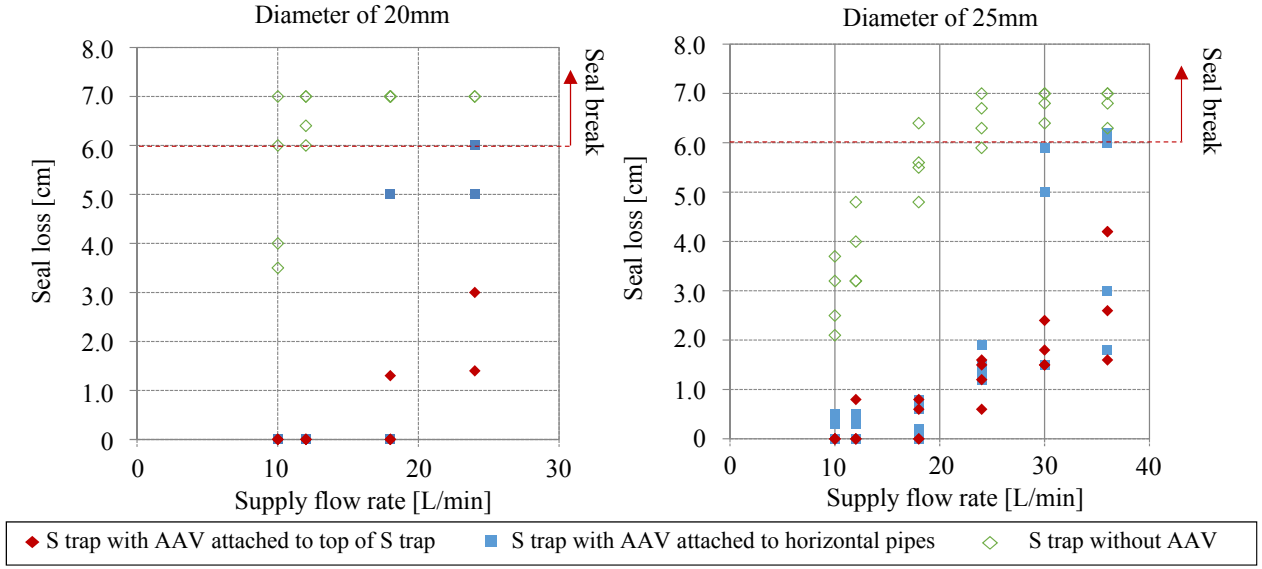
◆ S trap with AAV attached to top of S trap ■ S trap with AAV attached to horizontal pipes ◇ S trap without AAV

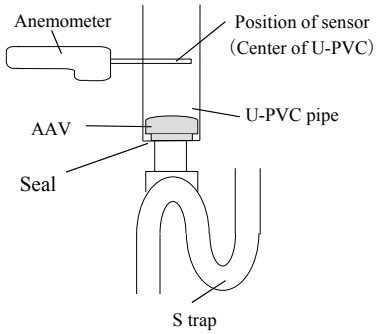
■ As there were no significant differences in flow phase for different experimental conditions, it is assumed that the attachment and positions of air admittance valves had little effects on flow phases.

■ Maximum siphonic negative pressure varied little in response to the differences in pipe diameter, attachment or positions of air admittance valves, but was affected by the heights of outflow heads.

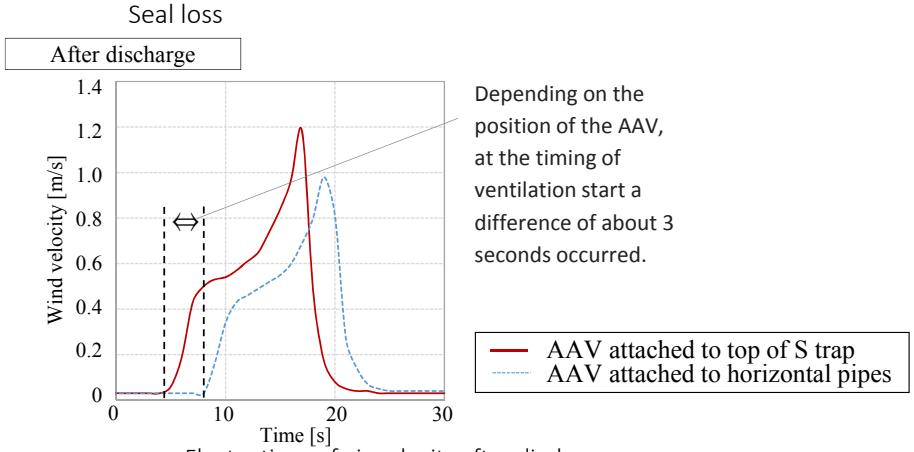
■ Neither did maximum flow velocity show significant differences due to attachment or positions of air admittance valves.

3. Result -CASE 1-





Imaege of method of measuring air velocity



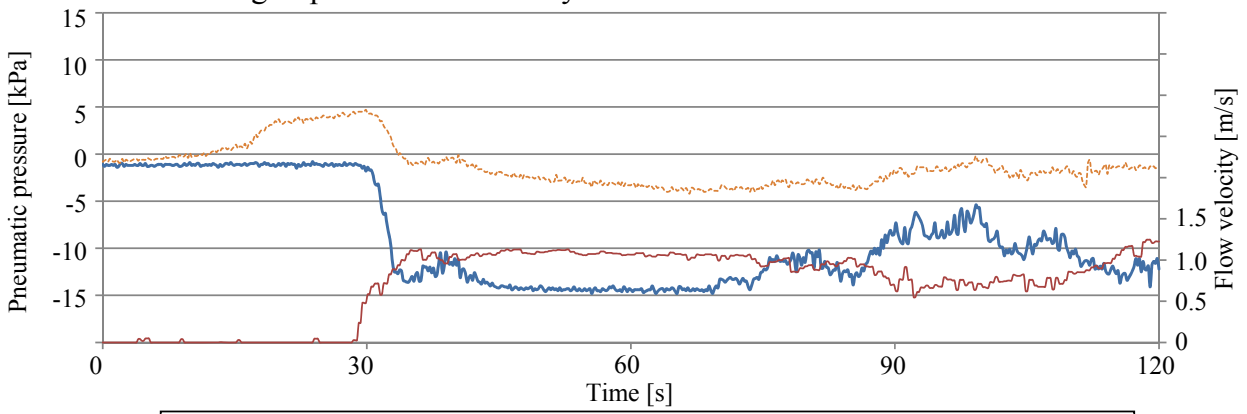
Fluctuations of air velocity after discharge
(with 20 A pipes, outflow heads of 2.0 m, supply flow rate 24 L/min)

■ Seal loss greatly reduced when air admittance valves were attached as opposed to when S traps only were used, but seal break occurred with large supply flow rates when air admittance valves were attached to horizontal pipes.
On the other hand, seal break did not occur when air admittance valves were attached to the top of traps with maximum seal loss of 3.0 cm in ϕ20mm and 4.2 cm in ϕ25mm.

■ Air flow tended to start about 3 seconds later when air admittance valves were attached to horizontal pipes than when they were attached to the top of S traps. This may explain why seal loss was larger when horizontal pipes were attached.

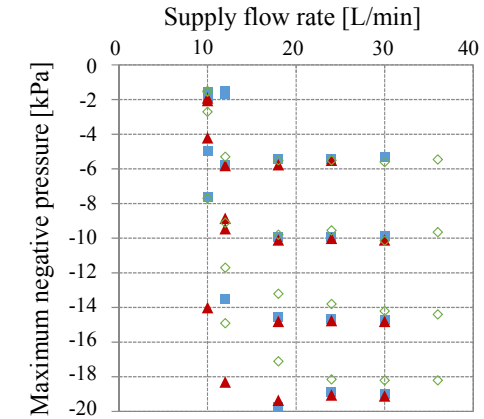
3. Result -CASE 2-

d) Self-sealing trap installed vertically

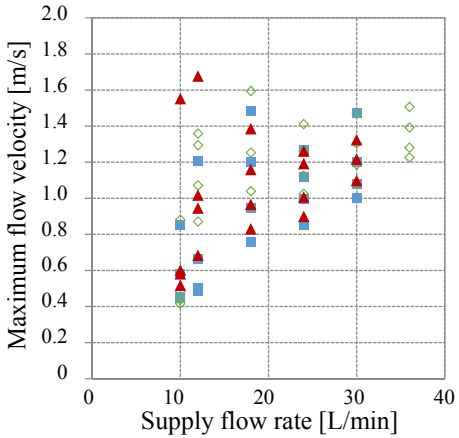


Fluctuations of pressures in drain and discharge flow velocity

(the condition of inflow part with self-sealing traps, ϕ25 mm pipes, outflow heads of 1.5 m, supply flow rate 24 L/min.)



Maximum siphonic negative pressure (ϕ25 mm pipes)



Maximum flow velocity (ϕ25 mm pipes)

◆ Self-sealing trap installed vertically ■ Self-sealing trap installed horizontally ◇ S trap without AAV

■ On the whole, flow phase showed similar patterns as with S trap when supply flow rate was low. However, discharge tended to fail more frequently when supply flow rate was large. Self-sealing traps are thought to be because resistance is larger than S trap.

■ Maximum siphonic negative pressure and maximum flow velocity showed similar values both with self-sealing trap and with S trap.

Noise Caused by Membrane viberation

■ Noise caused by membrane was heard during and after discharge in all experimental conditions. The noise seems to have been occurred as the membrane was pulled by negative pressure exerted on the inflow part during siphonic drainage.

4. Conclusion

The findings in this study can be summarized as follows:

CASE-1 With S trap + AAV

The effects of self-siphonage on seal loss differed according to the positions of air admittance valves. Valves operated quickly, and their protection of seal water was the most effective when they are attached to the top of traps (the inflow side of seal water).

CASE-2 With Self-sealing trap

Discharge failure tended to occur when self-sealing traps were attached to the inflow part with a large supply flow rate. Noise caused by membranes was also heard. Further studies are required to examine the nature of the noise occurred with self-sealing traps.