

An Investigation on the Residual Concentrations of Phosphate Corrosion Inhibitors in Cold and Hot Waters of Housing Complexes with Premises Galvanized Steel Pipes

Jong Soon Jung, Hyeon Hee Kim, Su Won Lee, Bog Soon Kim

Seoul Water Institute, Seoul Metropolitan Government

(E-mail : sjlab@seoul.go.kr)

Introduction

Residual concentrations of phosphate as a corrosion inhibitor for aged premises galvanized steel pipes to prevent corrosion and rust formation were measured in tap waters sampled from housing complexes in Seoul city. Since galvanized steel service lines and premises potable water pipes were banned in 1994 in Korea, the number of housing complexes using corrosion inhibitors to their premises galvanized pipes have decreased due to renovation or reconstruction of the aged houses. As of 2019 about 50 housing complexes inject corrosion inhibitors in their cold and/or hot waters in Seoul.

Once a year Seoul Waterworks Authority has collected cold and hot water samples from these housing complexes, measured the residual concentration of phosphates since 2015. The authority notifies the data to the house managers to adjust phosphate concentrations in the waters supplied from the aged premises galvanized steel pipes for the residents. Guideline of residual concentration of phosphate inhibitors is < 5 mg / L as P₂O₅.

Background

- To assist managers working at housing complexes with premises galvanized steel pipes to maintain the residual concentrations of phosphate corrosion inhibitors in their cold and hot waters for the residents

Guidelines regulation on Residual Concentration Of corrosion inhibitors

	KOREA	EU	USA	JAPAN
Residual concentration as P ₂ O ₅	Water treatment Guidelines 5 mg/L	Drinking water 5 mg/L	Water treatment plant 1~3 mg/L	Tap water 5 mg/L

Purpose of investigation

- Tap water after the water treatment process is supplied to the home through the water pipe and injected to prevent red water caused by the age of the pipe.

Effect on human body

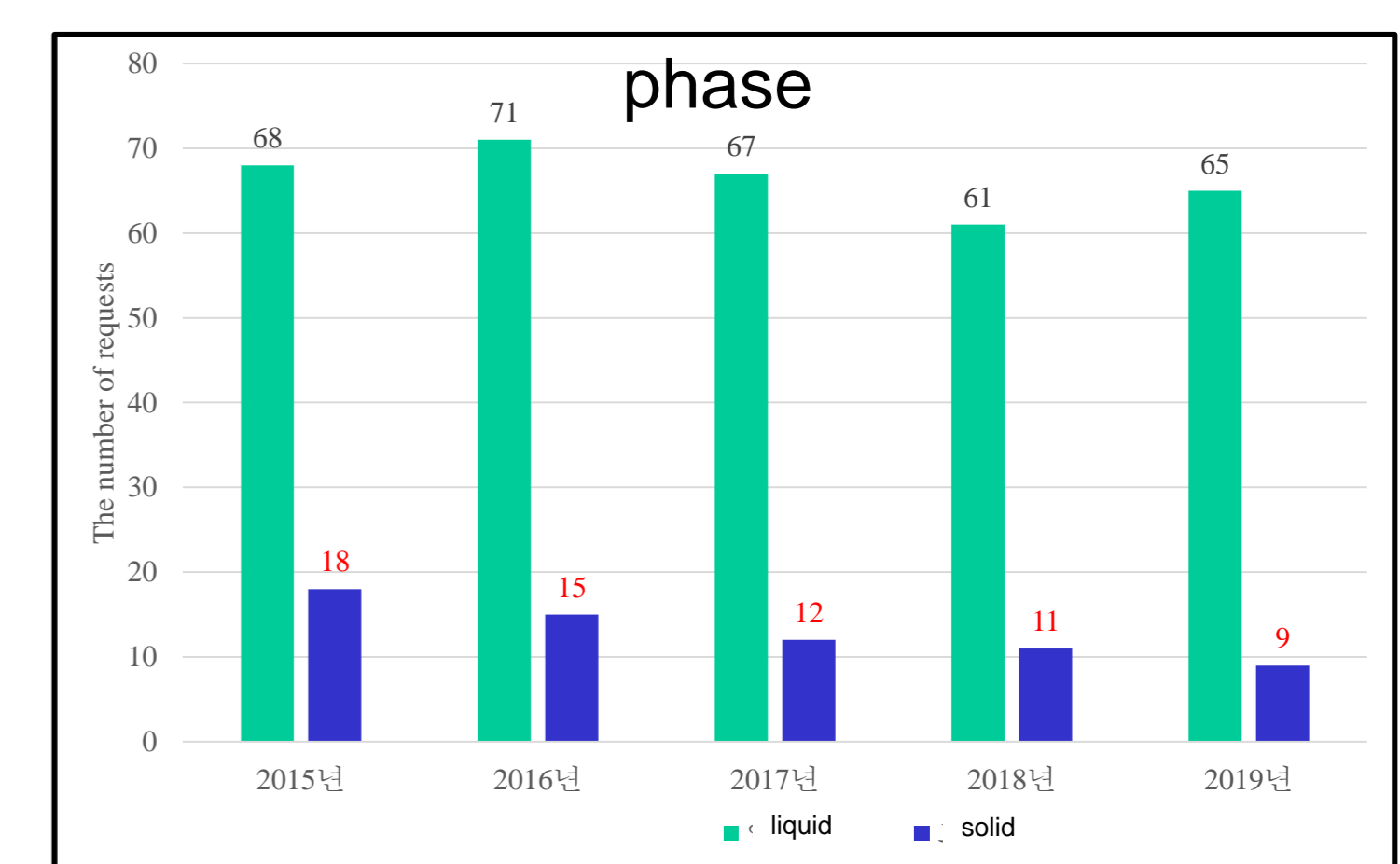
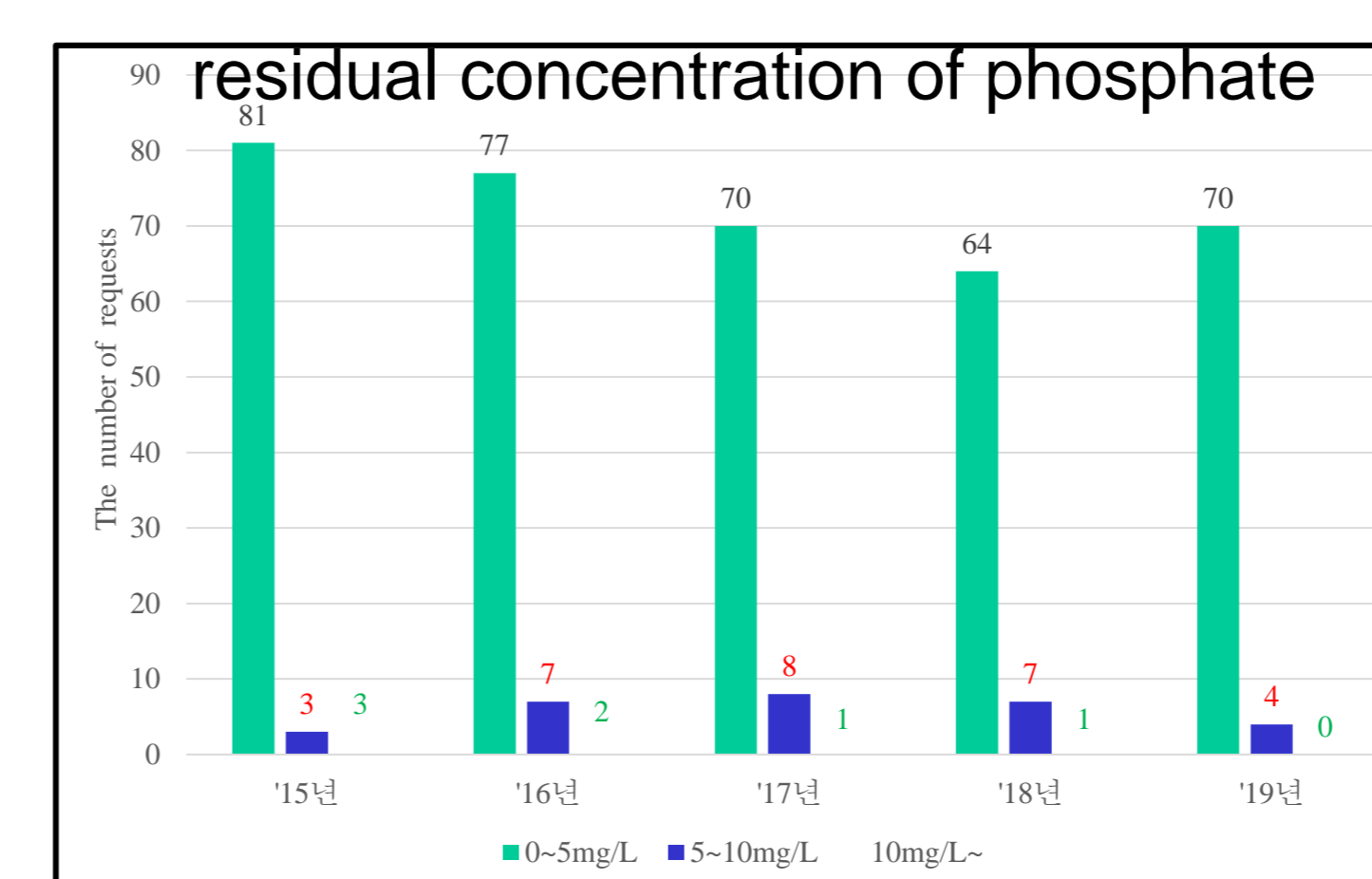
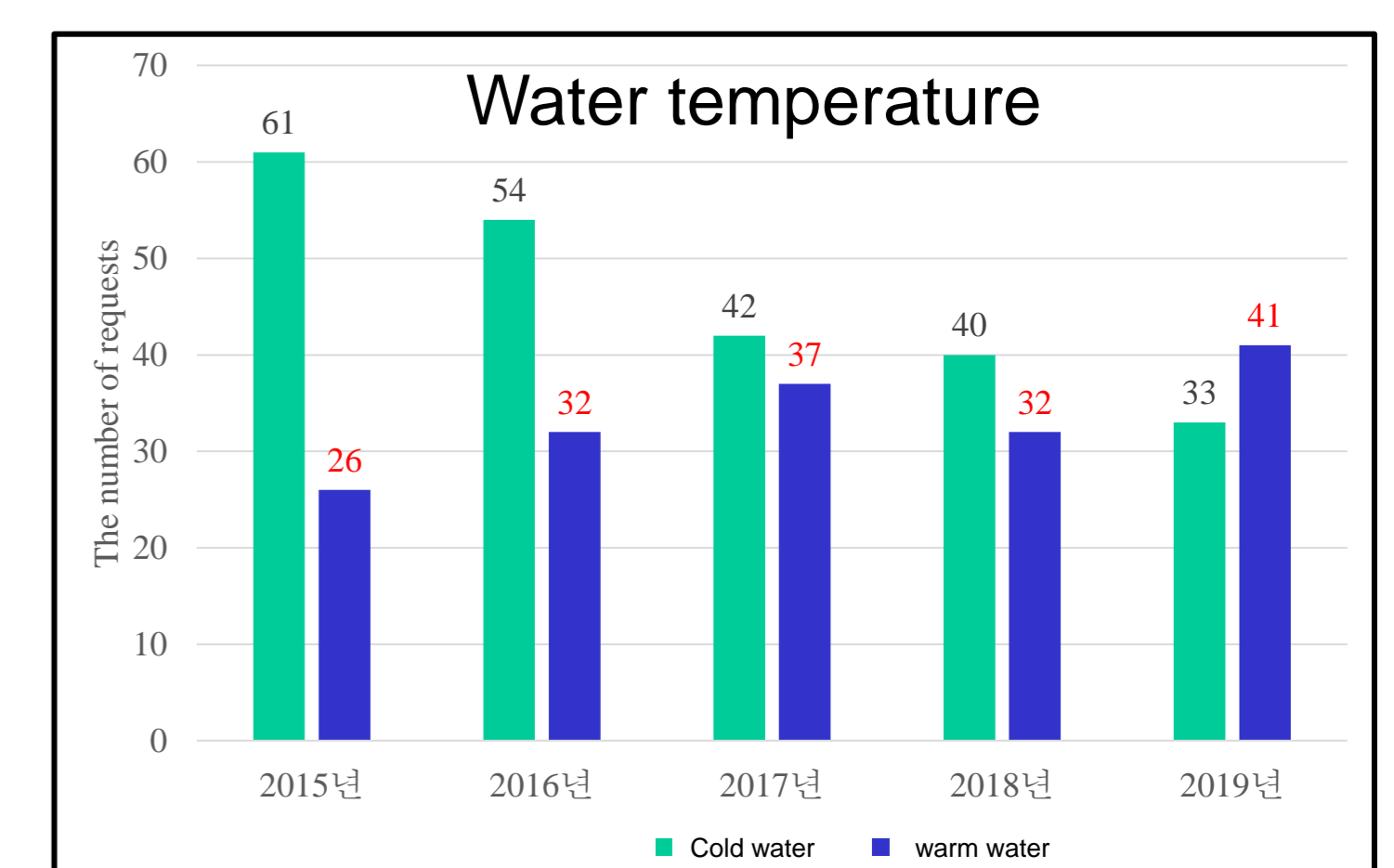
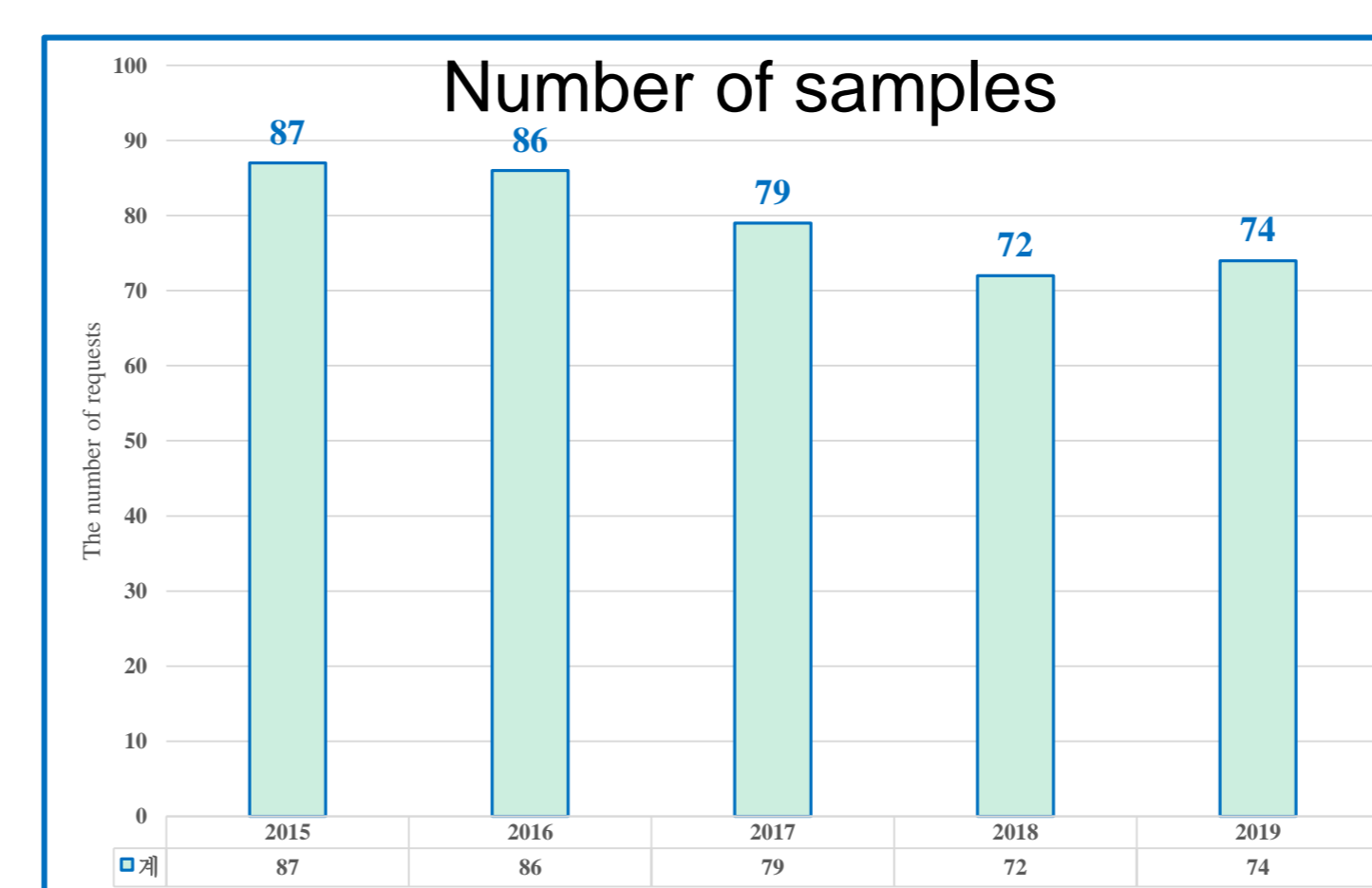
- Phosphate corrosion inhibitors did not show any harmful effects even if humans consumed 5-7 g of sodium monophosphate per day for a long time.
- Food and Agriculture Organization and World Health Organization estimated that the daily intake allowance is 70 mg / kg. Adults weighing 60 kg are allowed to take 4,200 mg in a day.
- If phosphate is excessively used in tap water, it forms sediment, so that the water containing less calcium and magnesium ions is more softened to promote corrosion of sewage pipes.
- According to animal clinical tests continuous consumption of water containing high concentration of phosphate may cause side effects such as vascular hardening, anemia, urethra, neurosis, renal failure, and hypertension due to deficiency of calcium in the body. It may cause eutrophication of water and add difficulty to sewage treatment.

Result

Types of Corrosion Inhibitors

Year	phosphate	Silicate	phosphate + Silicate
Guidelines	5 mg/L as P ₂ O ₅	10 mg/L as SiO ₂	10 mg/L as P ₂ O ₅ + SiO ₂
2008	95.9%	2.4%	1.7%
2010	96.9%	2.0%	1.1%
2013	100%	0.0%	0.0%
2019	100%	0.0%	0.0%

Year	The number of requests	The number of nonconformities	Average concentration (mg/L)	Detection range (mg/L)	Request Sample		State	
					Cold water	Warm water	Liquid	Solid
2015	87	6	1.93	0.00~11.8	61	26	69	18
2016	86	9	1.87	0.00~11.5	54	32	71	15
2017	79	9	1.99	0.02~10.2	42	37	67	12
2018	72	8	1.74	0.00~13.7	40	32	61	11
2019	74	4	1.58	0.00~9.16	33	41	65	9



The number of Samples	Residual concentrations (mg/L)		
	1st inspection	Secondary inspection	3rd inspection
69	< 5		
1	9.16	3.99	4.49
1	8.73	4.19	
1	5.11	1.91	
1	5.84	1.34	

- 4029 water samples were taken in 98 housing complexes using corrosion inhibitors during 2015~2019 in Seoul city. Corrosion inhibitors for aged premises galvanized steel pipes used in the complexes were only phosphates.
- The ratio exceeded 5 mg/L, guideline of residual concentration of phosphate inhibitors, was 5~11% and the average residual concentration ranged 1.58~1.99 mg/L.
- In 2019, 74 water samples were taken in 50 housing complexes. Samples consisted 33 cold and 41 warm water. Phosphates were input into the waters in 65 locations as liquid and in 9 locations as solid.
- Residual concentration of phosphate of 70 samples (95%) met the guideline of 5 mg/L as P₂O₅, 4 samples (5%) exceeded 5 mg/L and were all hot waters.
- Phosphates were injected at 1 complex as liquid and in 3 complexes as solid phase.
- Waters were resampled at the locations failed meeting the guideline. Sampling was conducted until each water met the guideline.

Conclusions

According to the Declaration No. 2008-69 of the Ministry of Environment only 'Guideline' is set on the residual concentration of corrosion inhibitors. There is no regulation or legal responsibility related to the compliance of the residual concentration of corrosion inhibitors. The City of Seoul gives a notice to the housing complexes where exceed the guideline and provides administrative recommendations and analytical data until they meet the guideline.

As shown in the results of the investigation excessive injection of phosphate gives rise to higher cost of chemicals and higher phosphorus emission to the environment in some housing complexes. It is necessary to take measures through legislation of regulations for exceeding residual concentration of corrosion inhibitors.