

Effect of flushing on the detachment of biofilms attached to the walls of metal pipes in water distribution systems

Jing-qing Liu, Zhi-feng Luo, Ke Liu, Yi-fu Zhang,
Hong-xi Peng, Bao-lan Hu, Hong-xing Ren, Xiao-yan Zhou,
Shang-de Qiu, Xiao-fang He, Hamid Bastani, Li-ping Lou

Cite this as: Jing-qing Liu, Zhi-feng Luo, Ke Liu, Yi-fu Zhang, Hong-xi Peng, Bao-lan Hu, Hong-xing Ren, Xiao-yan Zhou, Shang-de Qiu, Xiao-fang He, Ping Ye, Hamid Bastani, Li-ping Lou, 2017. Effect of flushing on the detachment of biofilms attached to the walls of metal pipes in water distribution systems. *Journal of Zhejiang University-SCIENCE A (Applied Physics & Engineering)*, 18(4):313-328.

<http://dx.doi.org/10.1631/jzus.A1600316>

Biofilms attached to the different metal pipe walls showed diverse forms.



DCIP



GCIP



SSCP

Morphology of biofilms on inner pipe walls before sampling

a. DCIPs(Ductile carbon iron pipes)

no obvious corrosion, biofilms distributed along the wall

b. GCIPs(gray cast iron pipes)

severe corrosion with lots of tubercles formed on the wall

c. SSCPs(stainless steel compound pipes)

smooth with no corrosion, relatively thin biofilms

Details of the flushing regime

Pipe material	Flushing regime	D (mm)	Re	Δ (mm)	Δ/d	λ	τ_0 (N/m ²)	V (m/s)
DCIP	Low shear stress	150	129259	0.15	0.001	0.022	2.0	0.86
	High shear stress	150	278056		0.001	0.021	9.0	1.85
GCIP	Low shear stress	150	100701	1.2	0.008	0.036	2.0	0.67
	High shear stress	150	213427		0.008	0.036	9.0	1.41
SSCP	Low shear stress	80	68938	0.025	0.000313	0.0215	2.0	0.86
	High shear stress	80	152305		0.000313	0.02	9.0	1.9

Conclusions

- ❑ Biofilms attached to the walls of different metal pipes have different resistance to flushing. The sensitivity of biofilms to flushing was significantly different among DCIPs, GCIPs and SSCPs.
- ❑ The resistance to flushing of different bacteria in metal pipes showed significant variation at both the class and genus levels.
- ❑ The resistance of bacteria to flushing was related not only to the nature of the bacteria, but also to the pipe material.