Supplementary Material 1

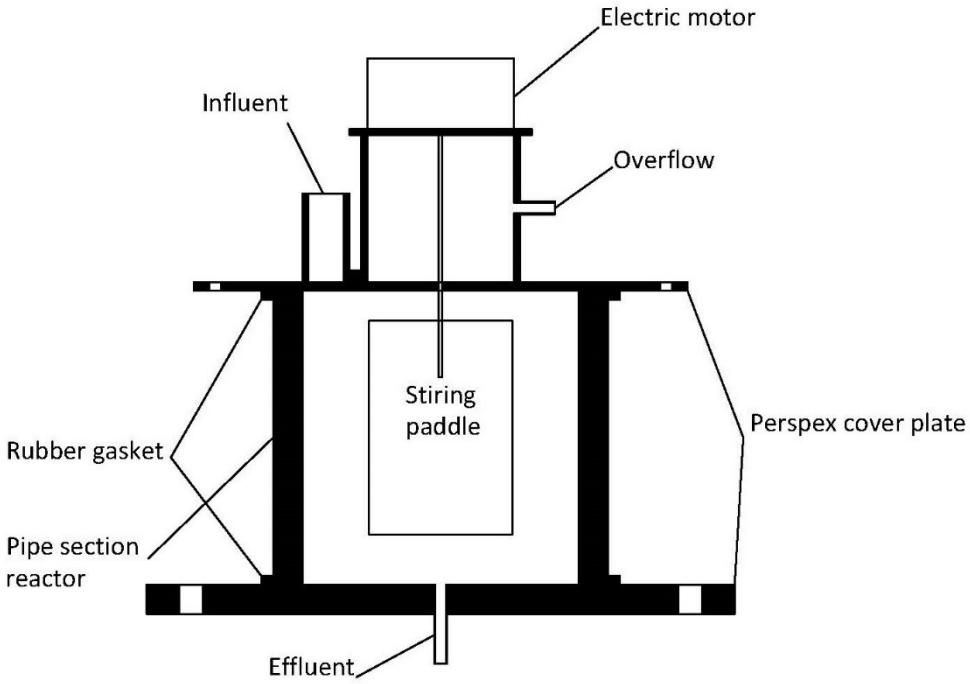


Fig. S1 Schematic of the pipeline simulation annular reactor

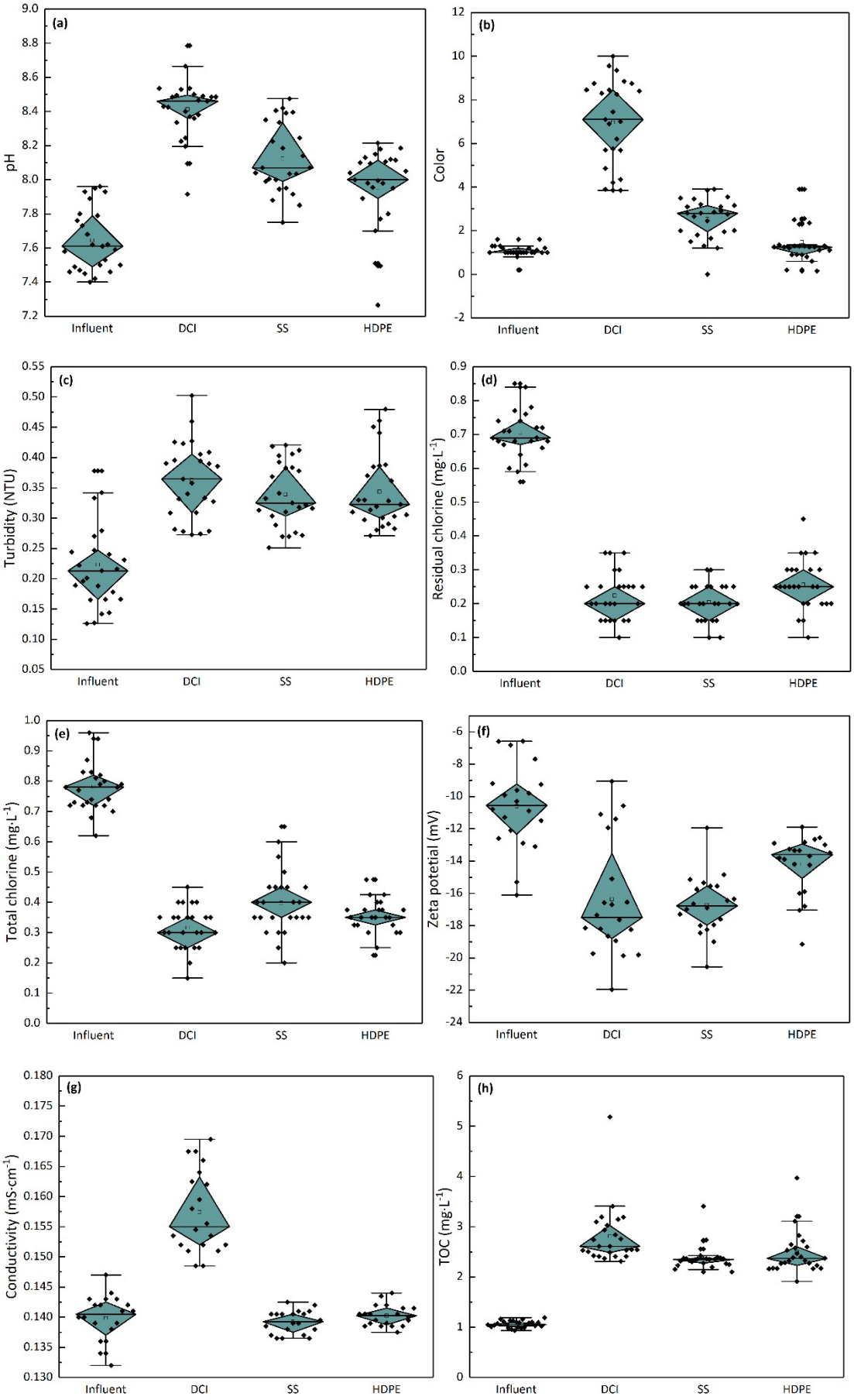

(a)
pH
9.0
8.8
8.6
8.4
8.2
8.0
7.8
7.6
7.4
7.2
Influent
DCI
SS
HDPE
(b)
Color
12
10
8
6
4
2
0
-2
Influent
DCI
SS
HDPE
(c)
Turbidity (NTU)
0.55
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
Influent
DCI
SS
HDPE
(d)
Residual chlorine (mg·L-1)
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
Influent
DCI
SS
HDPE
(e)
Total chlorine (mg·L-1)
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
Influent
DCI
SS
HDPE
(f)
Zeta potetial (mV)
-6
-8
-10
-12
-14
-16
-18
-20
-22
-24
Influent
DCI
SS
HDPE
(g)
Conductivity (mS·cm-1)
0.180
0.175
0.170
0.165
0.160
0.155
0.150
0.145
0.140
0.135
0.130
Influent
DCI
SS
HDPE
(h)
TOC (mg·L-1)
6
5
4
3
2
1
0
Influent
DCI
SS
HDPE

Fig. S2 Variation of water quality in AR systems

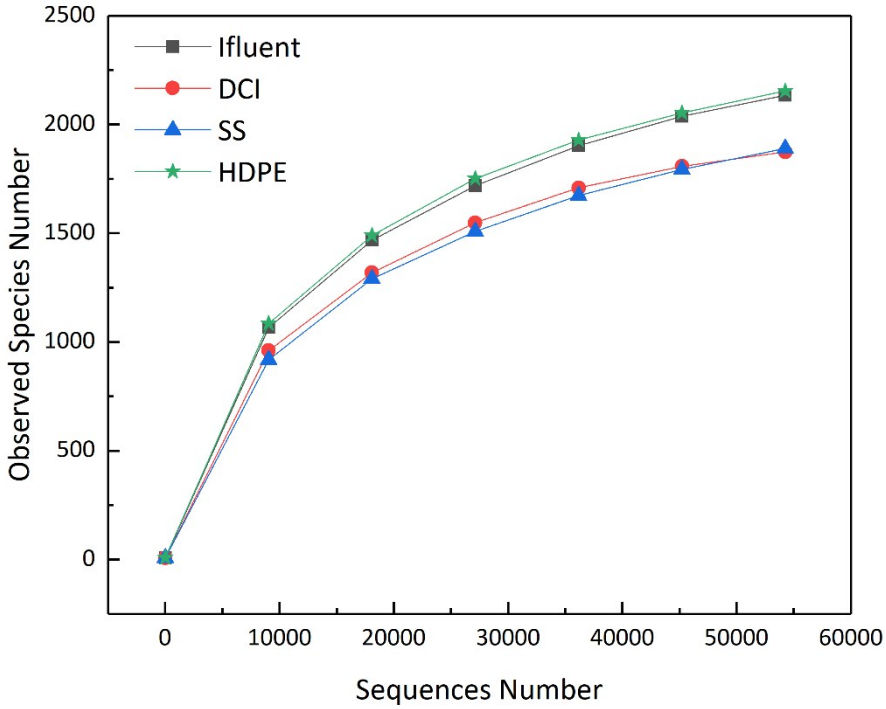


Fig. S3 Rarefaction curve

Note: The abscissa is the number of sequencing samples randomly extracted from a sample, the ordinate is the number of OUTs that can be constructed based on the number of sequencing numbers. It is used to reflect the sequencing depth. Different samples are represented by curves of different colors.

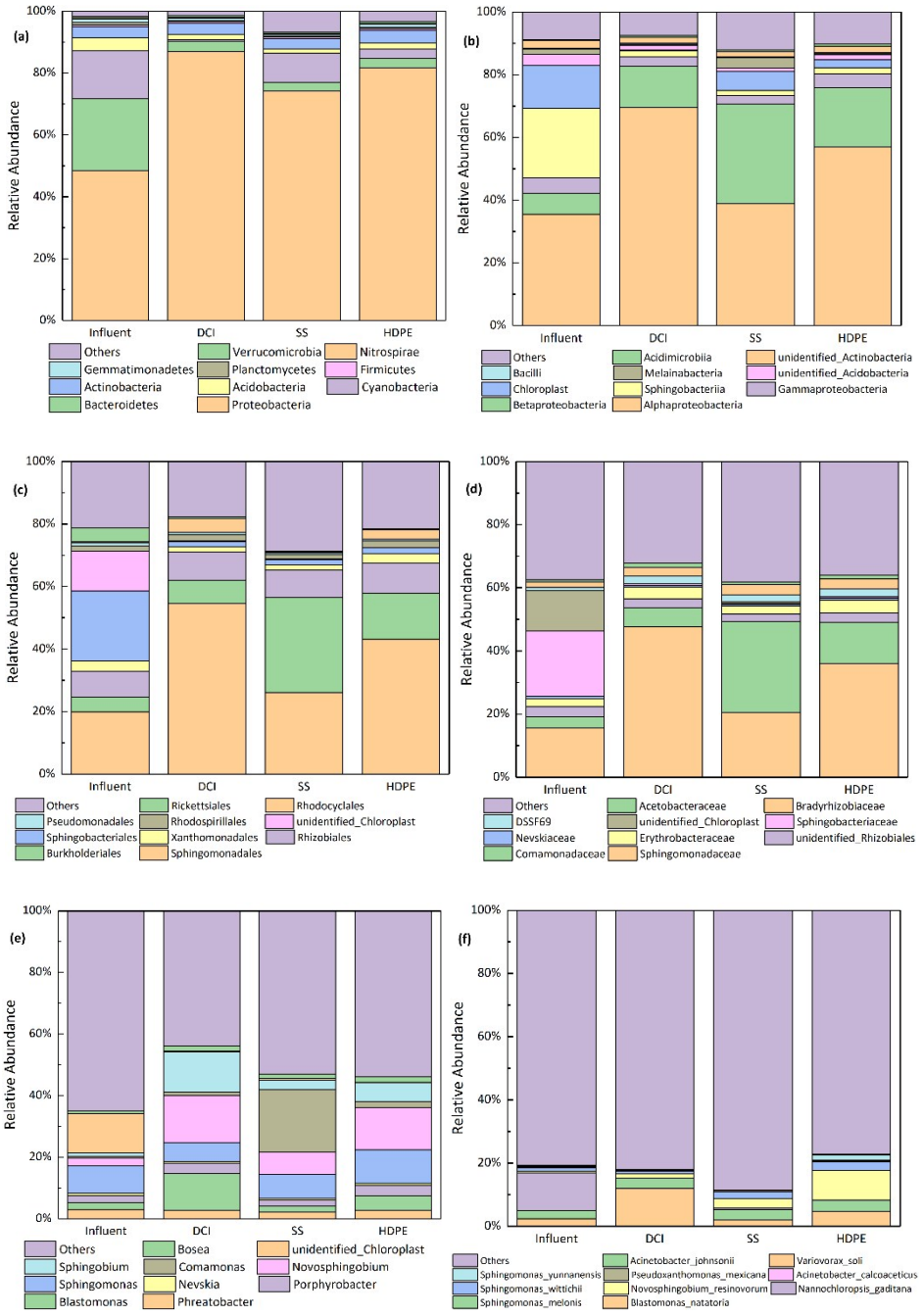


Fig. S4 Top 10 species with the highest abundance of each sample at each classification level

(From a to f, on behalf of the phylum, class, order, family, genus, and species, repectively)

Table S1 Test water quality and standard limits

	Influent water	National standard	Shenzhen standard
pH	7.4 ~ 7.96	6.5 ~ 8.5	7.0 ~ 8.5
Color	0 ~ 1.6	15	10
Turbidity	0.126 ~ 0.378 NTU	1 NTU	0.5 NTU
Residual chlorine	0.56 ~ 0.85 mg/L	≥0.3mg/L（TDW）	≥0.3 mg/L（TDW）
		≥0.05mg/L（EW）	≥0.05mg/L（EW）
Total chlorine	0.62 ~ 0.96 mg/L	≥0.5 mg/L（TDW）	-
		≥0.05mg/L（EW）	-
TOC	0.932 ~ 1.19 mg/L	5 mg/L	3 mg/L
Hardness	42.3~44.6 mg/L	450 mg/L	450 mg/L
Alkalinity	30.5~34.7 mg/L	-	-
Sulfate	9.86~10.47 mg/L	250 mg/L	250 mg/L
Chloride	10.42~14.57 mg/L	250 mg/L	250 mg/L
Zeta potential	-16.1 ~ -6.85 mV	-	-
Conductivity	0.132 ~ 0.147 mS/cm	-	-
Particle size distribution	0~200 nm	-	-

Note: (1) “-” indicates that the water quality indicator is not specified.

(2) “TDW” is “the treated water from the waterworks”.

(3) “EW” is “end water of drinking water distribution systems”.

Table S2 Major water quality monitoring parameters and test methods

	Test Methods
pH	HACH GQIId pH
Color	XINRUI SD9012AB water color meter
Turbidity	HACH 2100AN benchtop turbidity meter
Residual chlorine	HACH PCII single parameter colorimeter
Total chlorine	HACH PCII single parameter colorimeter
TOC	GE Sievers TOC
Zeta potential	Zetasizer Nano ZEN3600
Conductivity	Zetasizer Nano ZEN3600
Particle size distribution	Zetasizer Nano ZEN3600

Table S3 Community distribution of corrosion microorganisms at genus-level

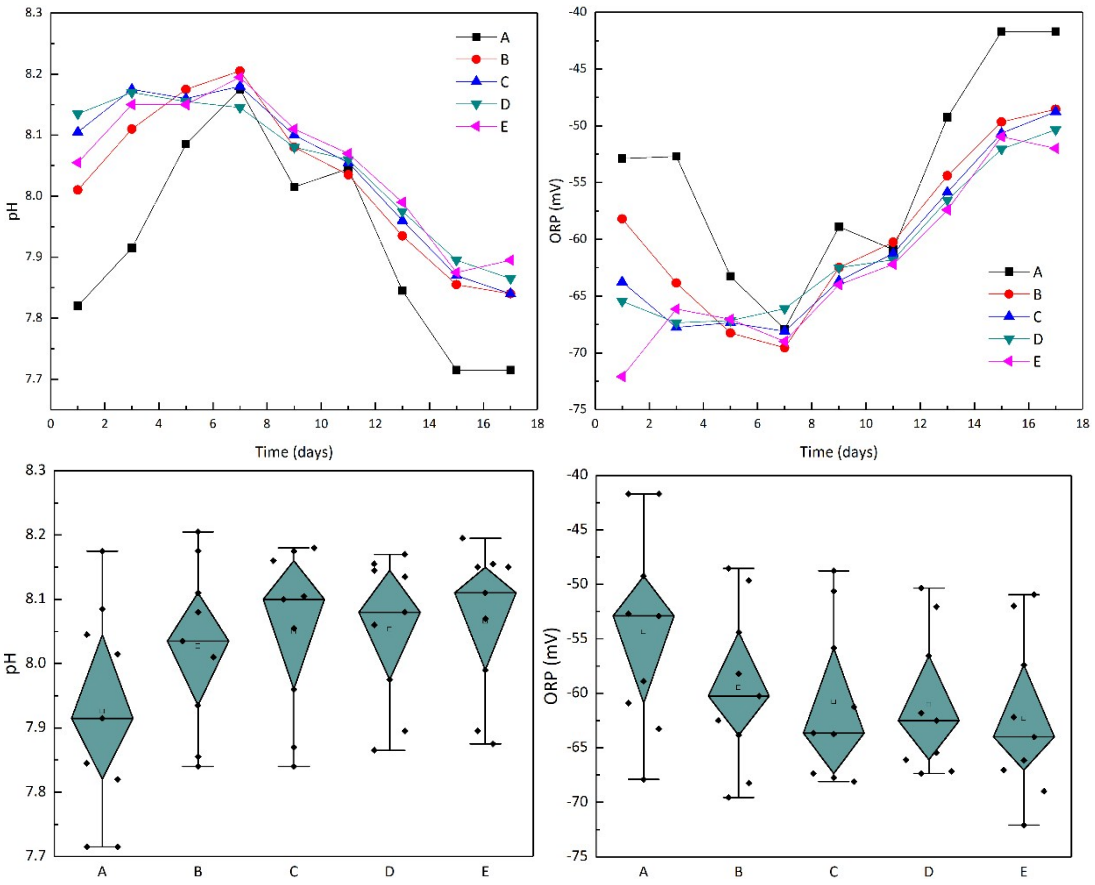
Functional bacteria		Functional bacteria community at Genus-Level
Iron cycling bacteria	IOB	Acidovorax，Aquabacterium，Bradyrhizobium，Pedomicrobium，Rhodanobacter，Sediminibacteriun，Thiobacillus，Gaiella
	IRB	Arthrobacter，Bacillus，Geothrix，Pseudomonas，Rhodobacter，Shewanella，Clostrium
Sulfur cycling bacteria	SOB	Thiobacillus
	SRB	Desulfobacca
Nitrogen cycling bacteria	NRB	Acinetobacter，Dechloromonas，Rhodocytophaga，Sphingomonas，Hydrogenophaga，Hyphomicrobium
	NFB	Azospirillum
APB		Massilia，Nocardioides，Propionibaoterium，Streptococcus

Characteristics of water quality change after transformation of Yantian District pipe network

There are 5 sampling locations, which are numbered A, B, C, D, and E. They are all the communities that have just completed the transformation of the pipe network. The pipes of the water supply pipe after replacement are stainless steel pipes, and the sampling points are the water intake of the water meter group.

1. pH and ORP variation characteristics

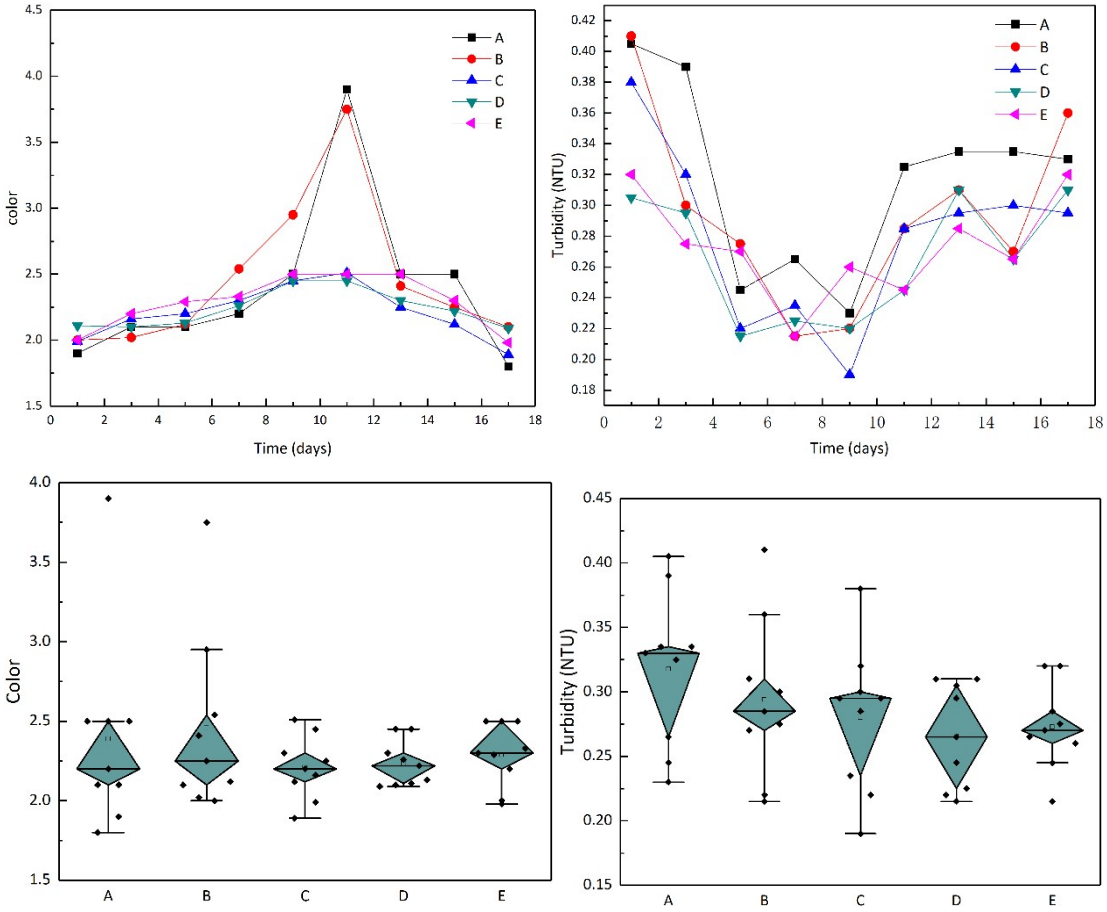
The variations of pH and ORP are consistent with the variation of laboratory simulation experiment, and the change trend of the two parameters is just the opposite. The pH of the five districts gradually decreased in the early stage and stabilized in the later stage, and the B, C, D and E remained at 7.9, but the pH of the A continued to be lower than the other four ones.



2. Color and turbidity

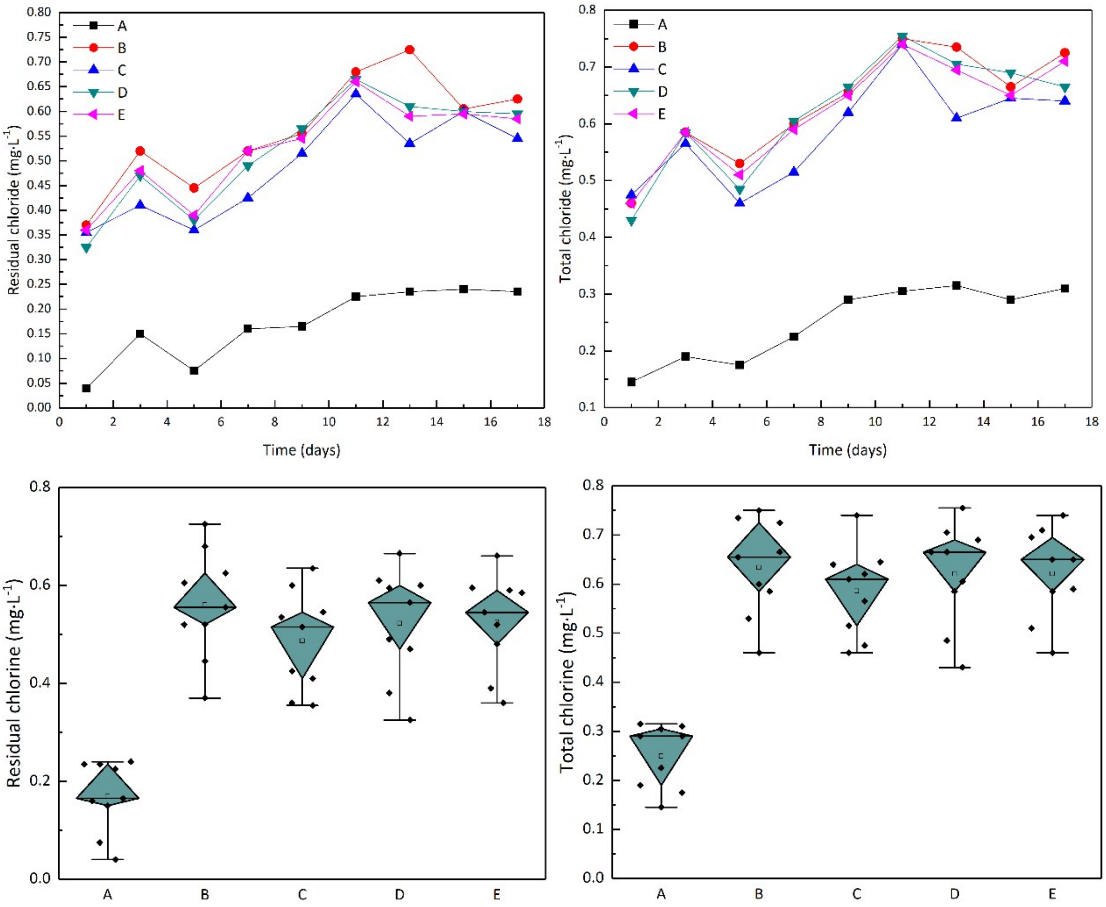
Changes in color and turbidity are in line with laboratory simulations. The tap water changes

of the five districts were consistent, the color first increased and then decreased, reaching the highest value in about 10 days, but the color of A and B were much higher than the other three ones on the 11th day. The turbidity values of the five were basically the same, showing a certain fluctuation, but always within 0.42 NTU.



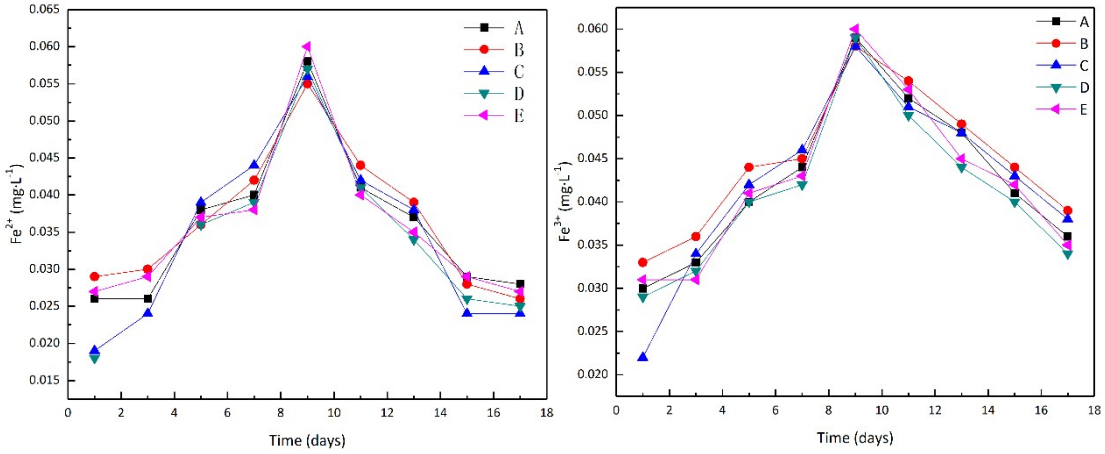
3. Residual chlorine and total chlorine

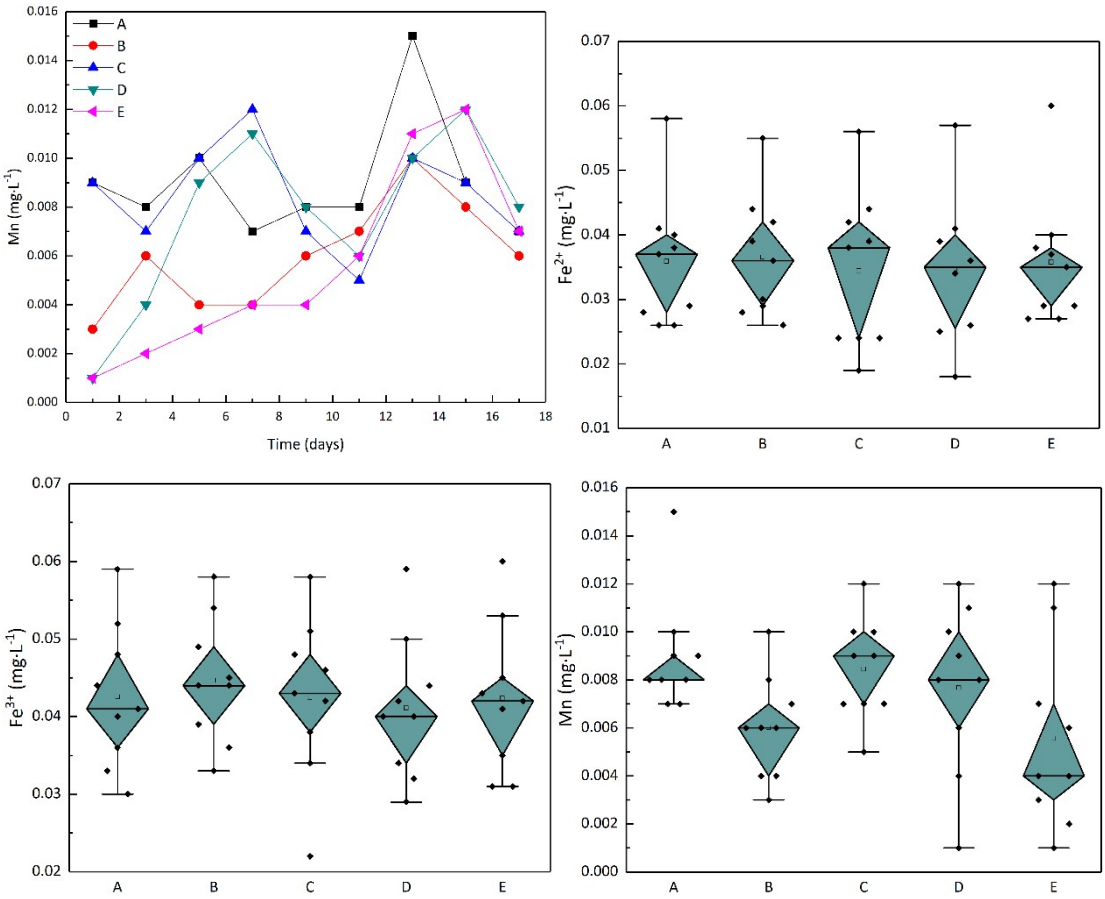
The residual chlorine and total chlorine curves are consistent with the laboratory simulation experiments, but there are some differences in the values. The residual chlorine and total chlorine in the actual water are higher than the laboratory simulation experiments. The reason may be due to the experimental values are measured after a long hydraulic stay, and the water in the actual community passes through the night, and the user's use promotes the flow of water in the morning, supplementing the residual chlorine and total chlorine value of the water.



4. Metal ions

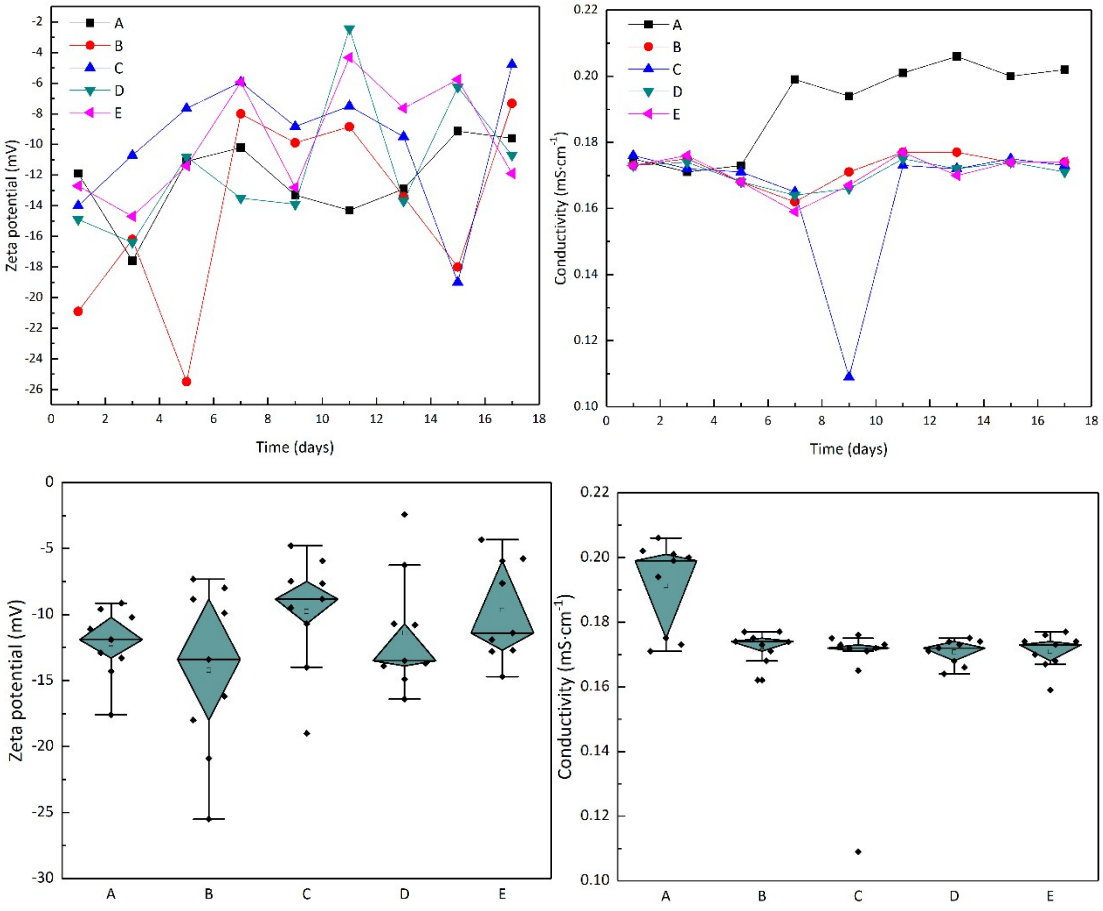
The laboratory simulation experiment did not detect the metal ion content. however, the content of Fe^{2+} and Fe^{3+} in the five districts showed a regulation of increasing first and then decreasing, and reached the maximum value on the 10th day, then gradually decreased and stabilized; The variation curve of manganese in the five districts has no good consistency with the change of Fe^{2+} and Fe^{3+}, but it also shows a gradual increase and then decreases and stabilizes. The manganese content is always maintained at a low level, and is much lower than Fe^{2+} and Fe^{3+}.





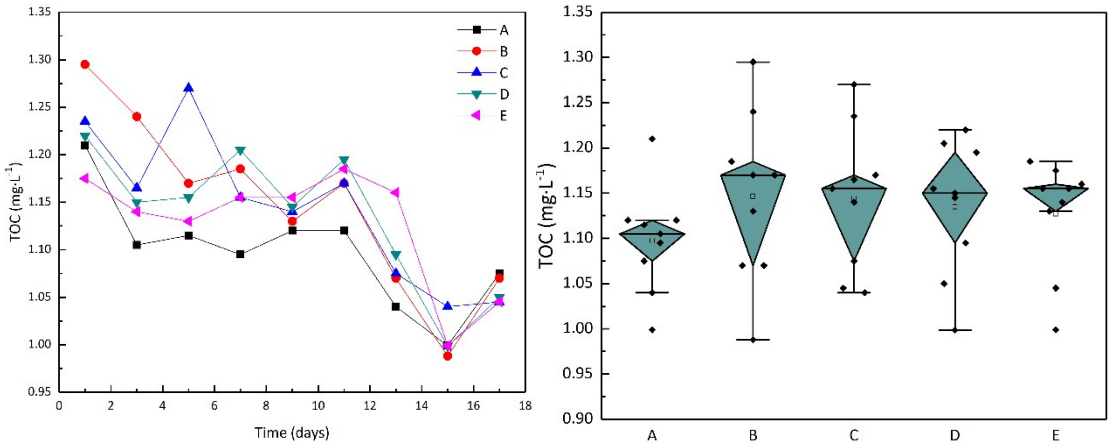
5. Zeta potential and conductivity

Zeta potential is the comprehensive effect of all charged substances in the reaction water body, the stability of the water body, and the conductivity content of the water in the reaction body. It is difficult to find the regulation of zeta potential from the line graph, but from the Zeta potential box pattern, it can be clearly seen that the water body stability trend of the five districts water bodies is B>D>E>A>C; the variation of the conductivity curves of the five is basically consistently, after the fifth day of the A, the conductivity of the water body is significantly higher than that of the other four ones. As can be seen from the box plot, the impurity content of the water in the five districts is A>E>B>D>C.



6. TOC

The trend of TOC is consistent with the results of laboratory simulations, which are gradually decreasing and tending to be stable. The TOC of the five are significantly lower than that of the laboratory simulation experiment. The main reason may be that the user uses water to cause the water to carry away some of the TOC. The difference in TOC content in the waters of the five can be clearly seen from the box plot: B>E>C>D>A.



7. Particle size distribution

The particle size distribution is consistent with the results of laboratory simulation experiments. The particle size of the water in the stainless steel tube is small, all within 500 nm.