Supporting information (SI)

Corrosion behavior and mechanism of ductile iron with different degrees of deterioration of cement mortar lining in reclaimed water pipelines

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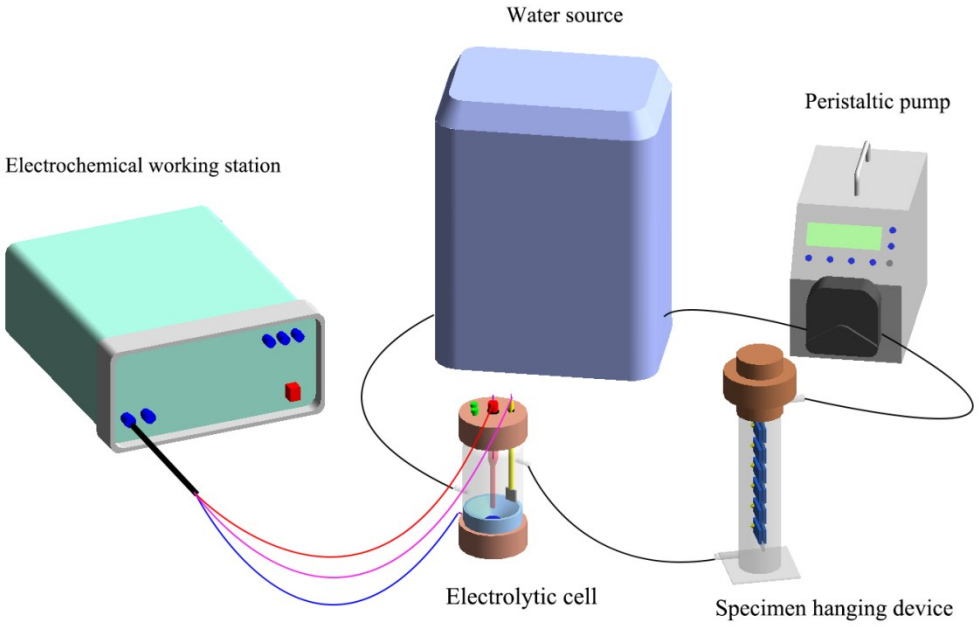

Figure S1 Schematic diagram of dynamic corrosion system.

Table S1 Corrosion current density and Tafel slopes of ductile iron with different cement mortar lining coverage.

Specimens	Time (d)	β_a (mV)	β_c (mV)	I_{coor} (mA/cm^2)
Lined (100% lining)	1	109.33	61.60	0.000486
	5	110.46	61.25	0.000535
	10	120.11	58.63	0.000518
	15	102.56	63.98	0.000571
	30	117.37	59.31	0.000556
	45	133.84	55.84	0.000550
	60	127.85	56.95	0.000560
	75	110.29	61.30	0.000509
90% lining	1	78.04	79.57	0.00256
	5	75.84	82.00	0.00331
	10	72.76	85.94	0.00291
	15	83.60	74.52	0.00238
	30	86.60	72.29	0.00177
	45	87.18	71.89	0.00164
	60	81.69	76.10	0.00163
	75	83.43	74.65	0.00123
50% lining	1	74.62	83.47	0.0108
	5	63.60	103.54	0.0116
	10	73.56	84.85	0.0125
	15	74.91	83.12	0.0114
	30	77.77	79.86	0.0082
	45	78.14	79.47	0.0067
	60	71.04	88.46	0.0065
	75	71.19	88.23	0.0057
Unlined	1	79.61	78.00	0.0086
	5	67.85	93.97	0.0078

	10	74.22	83.98	0.0074
	15	81.01	76.71	0.0070
	30	80.71	76.97	0.0065
	45	81.54	82.59	0.0062
	60	82.32	80.85	0.0059
	75	83.32	74.74	0.0056

Table S2 OCP data of experiments.

Time (d)	OCP (V)			
	Lined (100% lining)	90% lining	50% lining	Unlined
1	-0.62991	-0.61664	-0.64444	-0.59929
5	-0.65011	-0.60138	-0.65822	-0.62645
10	-0.65821	-0.60946	-0.64111	-0.61118
15	-0.65541	-0.57165	-0.62472	-0.60076
30	-0.66349	-0.56768	-0.63020	-0.57032
45	-0.68390	-0.51988	-0.62859	-0.65040
60	-0.68997	-0.59456	-0.64558	-0.59652
75	-0.67554	-0.58242	-0.64508	-0.52155

Table S3 ECM results of lined ductile iron.

Time (d)	R_s ($\Omega \cdot cm^2$)	R_{ct} ($\Omega \cdot cm^2$)	CPE_{ct} ($S \cdot sec^n/cm^2$)	n_{ct}	R_c ($\Omega \cdot cm^2$)	CPE_c ($S \cdot sec^n/cm^2$)	n_c
1 d	0.0007	7897	1.14×10^{-8}	0.768	39540	3.62×10^{-4}	0.676
5 d	0.0020	7834	5.16×10^{-9}	0.825	47009	4.41×10^{-4}	0.712
10 d	0.0006	8193	6.27×10^{-9}	0.789	51702	4.16×10^{-4}	0.723
15 d	0.0013	6687	6.14×10^{-9}	0.870	54443	5.32×10^{-4}	0.704
30 d	0.0008	8339	4.83×10^{-9}	0.835	58781	5.81×10^{-4}	0.722
45 d	0.0006	8803	1.59×10^{-8}	0.703	80543	6.37×10^{-4}	0.725
60 d	0.0024	10310	5.02×10^{-9}	0.853	104509	6.77×10^{-4}	0.715
75 d	0.0002	13120	3.07×10^{-9}	0.873	145620	7.08×10^{-4}	0.717

Table S4 ECM results of ductile iron with 90% lining coverage.

Time (d)	R_s ($\Omega \cdot cm^2$)	R_{ct} ($\Omega \cdot cm^2$)	CPE_{ct} ($S \cdot sec^n/cm^2$)	n_{ct}	R_{f+c} ($\Omega \cdot cm^2$)	CPE_{f+c} ($S \cdot sec^n/cm^2$)	n_2	/	/	/
1 d	444.3	1812	4.34×10^{-9}	0.994	4199	3.84×10^{-4}	0.403	/	/	/
5 d	369.9	1902	3.91×10^{-8}	0.809	3940	6.41×10^{-4}	0.505	/	/	/
10 d	23.11	1862	1.07×10^{-8}	0.763	4733	6.73×10^{-4}	0.413	/	/	/
Time (d)	R_s ($\Omega \cdot cm^2$)	R_{ct} ($\Omega \cdot cm^2$)	CPE_{ct} ($S \cdot sec^n/cm^2$)	n_{ct}	R_f ($\Omega \cdot cm^2$)	CPE_f ($S \cdot sec^n/cm^2$)	n_f	R_c ($\Omega \cdot cm^2$)	CPE_c ($S \cdot sec^n/cm^2$)	n_c
15 d	83.66	1889	6.40×10^{-9}	0.858	2005	8.12×10^{-5}	0.512	4121	1.07×10^{-3}	0.713
30 d	279.6	1998	5.35×10^{-9}	0.912	2513	8.67×10^{-5}	0.438	6231	9.84×10^{-5}	0.703
45 d	249.6	2091	5.81×10^{-9}	0.899	2991	7.71×10^{-5}	0.438	8068	9.48×10^{-4}	0.711
60 d	312.6	2226	4.07×10^{-9}	0.937	6536	4.58×10^{-4}	0.510	16418	2.05×10^{-4}	0.455
75 d	62.19	3038	4.41×10^{-9}	0.882	8265	3.93×10^{-5}	0.523	25221	2.38×10^{-4}	0.413

Table S5 ECM results of ductile iron with 50% lining coverage.

Time (d)	R_s ($\Omega \cdot cm^2$)	R_{ct} ($\Omega \cdot cm^2$)	CPE_{ct} ($S \cdot sec^n/cm^2$)	n_{ct}	R_{f+c} ($\Omega \cdot cm^2$)	CPE_{f+c} ($S \cdot sec^n/cm^2$)	n_{f+c}
1 d	54.26	1216	3.55×10^{-8}	0.857	416.0	0.001302	0.891
5 d	42.10	1018	3.28×10^{-8}	0.810	601.6	0.001623	0.869
10 d	43.19	1032	2.82×10^{-8}	0.812	450.7	0.001772	0.863
15 d	48.14	1099	2.36×10^{-8}	0.813	551.9	0.001470	0.605
30 d	49.03	1186	2.01×10^{-8}	0.818	2032.0	0.000983	0.310
45 d	51.05	1175	2.31×10^{-8}	0.821	2131.0	0.000868	0.333
60 d	63.34	1171	2.52×10^{-8}	0.856	2177.0	0.000896	0.392
75 d	82.51	1191	2.11×10^{-8}	0.855	2282.0	0.000885	0.406

Table S6 ECM results of unlined ductile iron.

Time (d)	R_s ($\Omega \cdot cm^2$)	R_{ct} ($\Omega \cdot cm^2$)	CPE_{ct} ($S \cdot sec^n/cm^2$)	n_{ct}	R_f ($\Omega \cdot cm^2$)	CPE_f ($S \cdot sec^n/cm^2$)	n_f
1 d	62.1	922.4	2.29×10^{-8}	0.897	972	0.001324	0.478
5 d	53.4	913.6	3.15×10^{-8}	0.772	1373	0.001111	0.551
10 d	57.4	921.0	2.76×10^{-8}	0.788	1569	0.001064	0.484
15 d	66.6	934.1	2.53×10^{-8}	0.793	1526	0.000996	0.491
30 d	67.5	949.0	2.73×10^{-8}	0.811	2235	0.001034	0.443
45 d	75.7	1026.1	2.90×10^{-8}	0.804	1494	0.000867	0.489
60 d	81.7	1010.5	2.46×10^{-8}	0.840	1621	0.001006	0.458
75 d	83.8	1021.2	1.79×10^{-8}	0.857	1571	0.001075	0.416

Table S7 Polarization resistance (R_p) measured by polarization curve and EIS at different corrosion time.

	R_p ($\Omega \cdot cm^2$) - Polarization data				R_p ($\Omega \cdot cm^2$) - Impedance data			
Time (d)	Lined (100% lining)	90% lining	50% lining	Unlined	Lined (100% lining)	90% lining	50% lining	Unlined
1 d	34587	6850.3	1538.5	2011.7	47437	6111.0	1632.0	1894.4
5 d	32610	5408.1	1524.8	2296.6	54843	5392.0	1619.6	2286.6
10 d	33300	6129.6	1352.3	2376.2	59895	6239.0	1482.7	2490.0
15 d	30421	7206.5	1476.9	2404.7	58383	8015.0	1650.9	2460.1
30 d	28794	9738.4	2154.1	2635.6	60772	10760	3218.0	3184.0
45 d	31376	10715	2599.2	2886.1	63421	13150	3306.0	2520.1
60 d	30988	10609	2747.6	2980.1	94819	25180	3348.0	2631.5
75 d	34612	14206	3196.1	3725.4	100021	36524	3473.0	2592.2