SUPPORTING INFORMATION

Dezincification of Brass Water Meters in a Long-term Study: Effects of Anions, Alkalinity, and Residual Chlorine in Tap Water

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Table S1 Characteristics of Hsinchu tap water

Water quality	Value
pH	7.93±0.19
Free chlorine (mg/L)	0.16±0.15
Conductivity (μS/cm)	300±29
Turbidity (NTU)	0.23±1.0
Hardness (mg/L)	122±17
Alkalinity (mg/L)	120±19
Sulphate (mg/L)	46.9±9
Chloride (mg/L)	11.3±4.1

Text S1

Table S2 shows the change of water qualities for various synthetic waters. In the high Alk groups ($A_{High}B_{High}C_{Low}$ and $A_{High}B_{High}C_{High}$), average Alk slightly decreased from 230 to 191 mg/L after 7-day exposure of tested water and water meter. By contrast, an insignificant change (< 10%) was observed in the low Alk groups as well as the control group. For low RC groups ($A_{High}B_{High}C_{Low}$ and $A_{High}B_{Low}C_{Low}$), DO decreased from 8.64±0.2 to 7.06±0.6 mg/L, while it decreased from 8.91±0.2 to 7.94±0.1 mg/L in the high RC groups ($A_{High}B_{High}C_{High}$ and $A_{High}B_{Low}C_{High}$). On the contrary, low RC slightly reduced the ORP (ΔORP: 150±84 mV) which is much lower than that in the high RC condition (ΔORP: 409.0±4.9 mV). An overall increase in

pH from around 8.09 to around 8.25 was found in all tested groups after 7-day exposure. This was likely attributed to the oxygen reduction reaction (ORR, $O_2 + 2H_2O + 4e^- \rightarrow 4OH^-$). The pH ~8.2 on the 7^{th} day occurred in all tested groups might indicate a favorable pH condition for dezincification, as reported by Mahdy *et al.* (2013).

Table S2 Change of water qualities for various synthetic waters

	Day	Alkalinity (mg/L as $CaCO_3$)	DO (mg/L)	ORP (mV)	pH	Conductivity (μS/cm)	Chlorine (mg/L as Cl_2)	Sulfate (mg/L)	Chloride (mg/L)
$A_{Low}B_{Low}C_{Low}$	1st	129±23	8.85±1.0	466±181	8.09±0.1	316±114	0.49±0.6	62±7	6.42±1.2
	7th	120±10	7.46±1.0	262±3	8.20±0.2	286±5	0.04±0.1	64±12	6.25±0.4
$A_{High}B_{High}C_{Low}$	1st	229±28	8.36±1.6	343±122	8.07±0.1	639±84	0.31±0.2	115±11	66.93±2.6
	7th	188±27	6.42±1.8	253±11	8.26±0.2	623±56	0.05±0.1	84±57	59.95±6.2
$A_{High}B_{High}C_{High}$	1st	230±21	9.09±0.4	638±55	8.08±0.2	631±140	1.01±1.1	116±1.2	59.25±3.1
	7th	194±28	8.01±0.8	232±17	8.25±0.3	637±44	0.29±0.2	127±7.4	61.99±2.2
$A_{High}B_{Low}C_{Low}$	1st	120±12	8.71±1.1	443±103	8.09±0.1	530±23	0.24±0.1	115±14	52.29±3.5
	7th	114±9.4	7.29±1.1	233±17	8.18±0.2	526±23	0.04±0.1	126±10	56.99±9.0
$A_{High}B_{Low}C_{High}$	1st	120±0.0	8.74±1.2	640±41	8.11±0.1	558±68	1.00±1.3	125±7.3	59.52±2.8
	7th	120±7.1	7.87±1.2	227±16	8.21±0.2	536±44	0.18±0.1	122±9.2	55.58±4.8

Errors indicate the replicate of over 90 measurements

High concentration: $_{High}$, Low concentration: $_{Low}$

Anions: A; Alkalinity (bicarbonate): B, Residual chlorine: C

Dissolved oxygen: DO, oxidation reduction potential: ORP

Table S3 Leaching rate of Zn and Cu of brass water meters under various mixed parameters water quality

Mixed water parameters	Day 0-30 (mg/L day)		Day 31-240 (mg/L day)		Day 240-360 (mg/L day)	
	Zn	**Cu**	**Zn**	**Cu**	**Zn**	**Cu**
$\mathbf{A_{Low}B_{Low}C_{Low}}$	0.550 (0.97)	0.073 (0.96)	0.310 (0.96)	0.027 (0.95)	0.330 (0.68)	0.004 (0.94)
$\mathbf{A_{High}B_{High}C_{Low}}$	0.590 (0.93)	0.010 (0.90)	0.380 (0.95)	0.007 (0.81)	0.360 (0.72)	0.003 (0.97)
$\mathbf{A_{High}B_{High}C_{High}}$	0.590 (0.93)	0.070 (0.94)	0.420 (0.98)	0.011 (0.89)	0.360 (0.70)	0.004 (0.96)
$\mathbf{A_{High}B_{Low}C_{Low}}$	0.720 (0.92)	0.010 (0.90)	0.540 (0.99)	0.003 (0.87)	0.390 (0.66)	0.003 (0.97)
$\mathbf{A_{High}B_{Low}C_{High}}$	0.720 (0.92)	0.010 (0.90)	0.590 (0.99)	0.005 (0.97)	0.390 (0.70)	0.003 (0.98)

Anions: A; Alkalinity (bicarbonate): B; Residual chlorine: C.

High concentration: $_{High}$; Low concentration: $_{Low}$.

Leaching rate= $\frac{\Delta\, Concentration\ of\ Zinc\ or\ Copper}{\Delta\, Day}$

The number in the blanket indicates the R^2 value

Table S4 Quantified chemical composition of the scale formed by ICP-OES

Testing groups	Al	K	Ca	Mn	Fe	Ni	Cu	Zn	Pb	Mg
	mg/g scale									
$\mathbf{A_{Low}B_{Low}C_{Low}}$	32.6	0.00	2.20	0.22	1.60	2.32	6.12	437	1.13	0.36
$\mathbf{A_{High}B_{High}C_{Low}}$	21.5	0.29	4.55	0.11	2.76	0.50	4.98	428	1.12	0.39
$\mathbf{A_{High}B_{High}C_{High}}$	12.6	0.00	3.60	0.30	2.67	2.71	4.45	459	1.62	0.44
$\mathbf{A_{High}B_{Low}C_{Low}}$	18.6	0.19	2.05	0.11	6.99	1.66	3.11	485	1.94	0.44
$\mathbf{A_{High}B_{Low}C_{High}}$	19.7	0.30	2.41	0.13	3.93	1.68	2.99	477	1.31	0.91

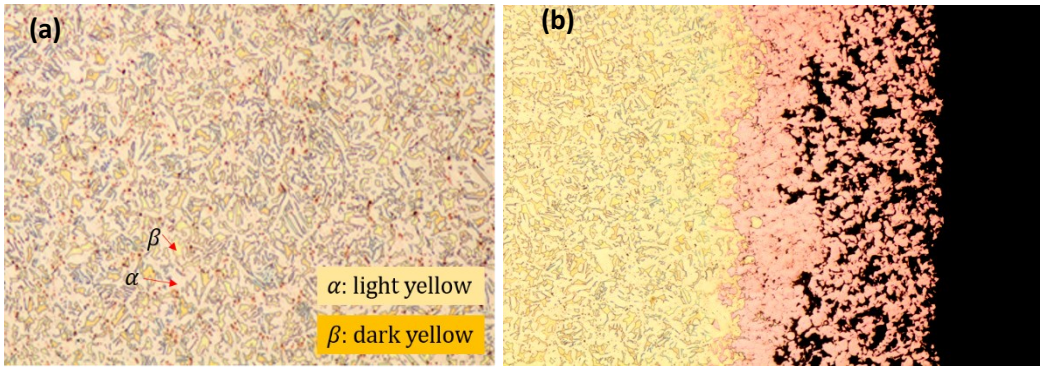

Fig. S1 The OM images of brass water meters for (a) the metallographic structure and (b) the dezincification depth.

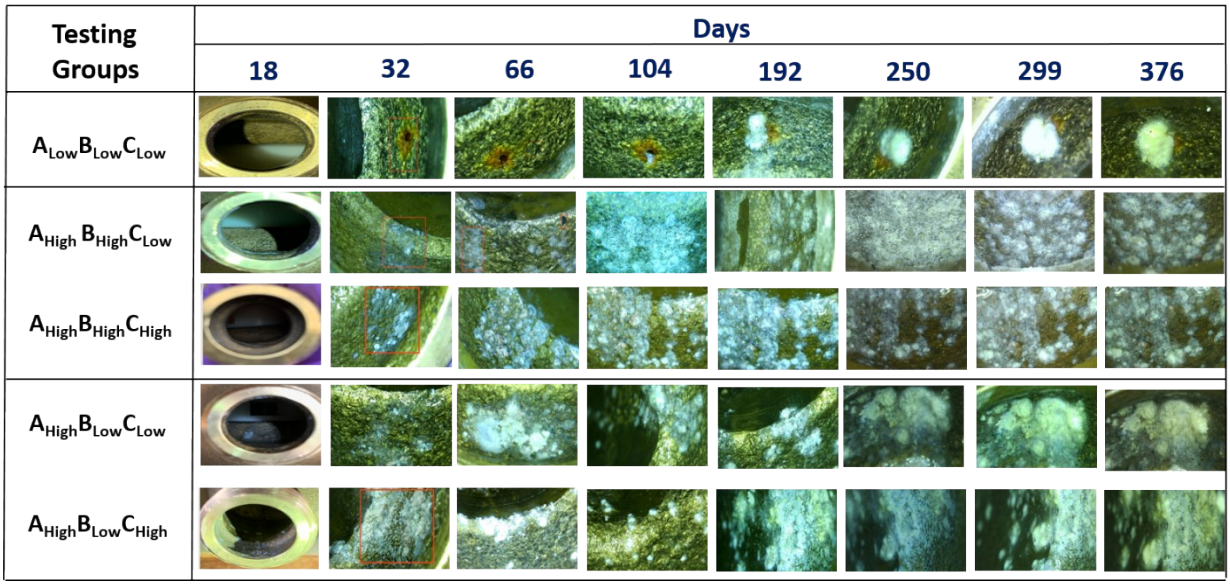

Fig. S2 Scale formation on the brass water meters in the water under various mixed parameters during the 376-day experiment.

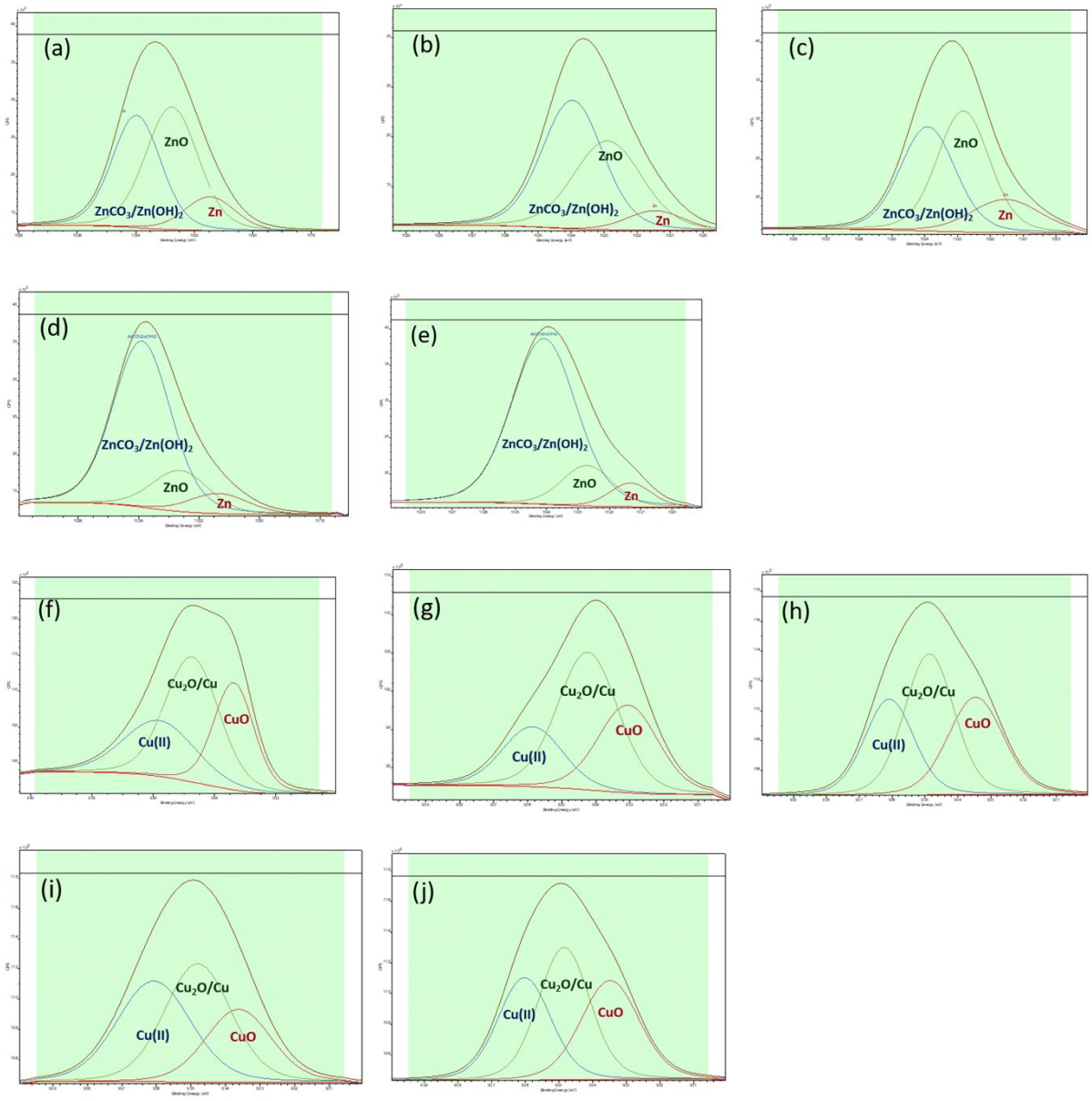

Fig. S3 The XPS core-level spectra of (a-e) Zn $2p_{3/2}$ and (f-j) Cu $2p_{3/2}$ in the scale formed from water under various mixed parameters (a and f): $A_{Low}B_{Low}C_{Low}$, (b and g): $A_{High}B_{High}C_{Low}$, (c and h): $A_{High}B_{High}C_{High}$, (d and i): $A_{High}B_{Low}C_{Low}$, (e and j): $A_{High}B_{Low}C_{High}$

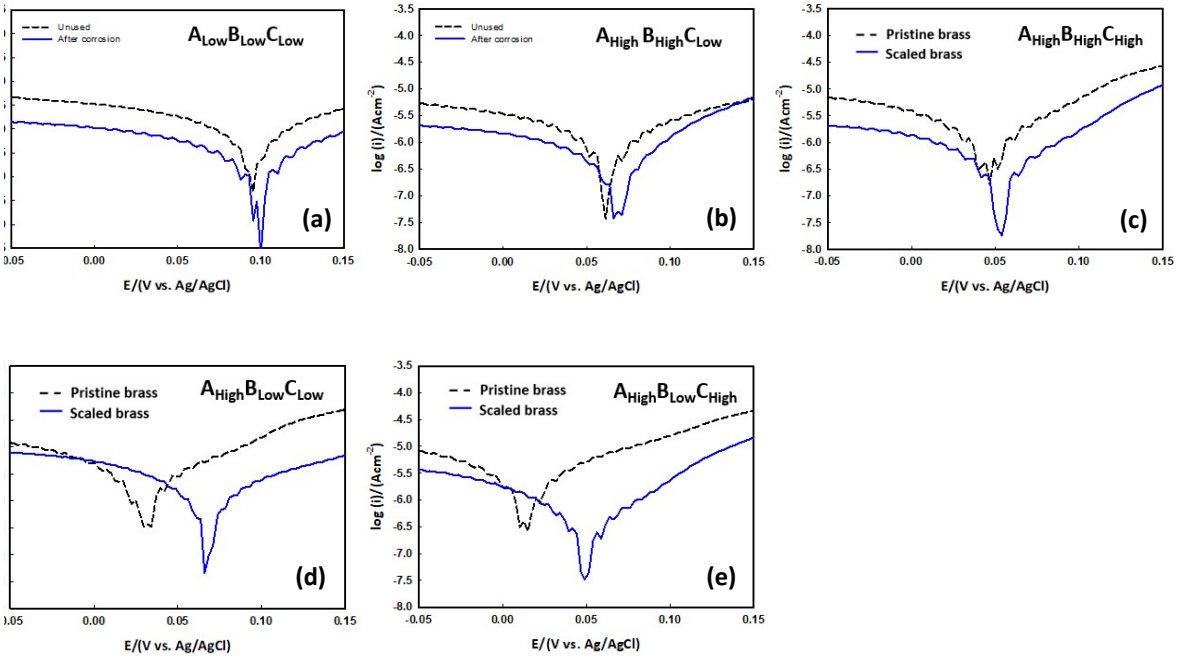

Fig. S4 The positive shift in E_{corr} of the pristine and scaled brass chips in the water under various mixed parameters: (a) $A_{Low}B_{Low}C_{Low}$ (b) $A_{High}B_{High}C_{Low}$ (c) $A_{High}B_{High}C_{High}$ (d) $A_{High}B_{Low}C_{Low}$ (e) $A_{High}B_{Low}C_{High}$.