Electrocoagulation: A promising method to treat and reuse mineral processing wastewater with high COD

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The so-called peroxi-electrocoagulation (PEC) externally is adding H_2O_2 in electrochemical reactor with iron anode plate [1]. Fe^{2+} produced from the sacrificial of iron anode and H_2O_2 can generate a powerful oxidants named hydroxyl radicals (OH·) during PEC process. Because of the instable of H_2O_2 at a basic region [2], an initial pH of 3.0 was adopted in the process. Unexpectedly, as it can be seen from Fig. S1, the efficiency of electrocoagulation gradually decreases with the increasing H_2O_2 dosage and the lowest efficiency is obtained at 563.31mg/L. But the further increasing of H_2O_2 dosage results in the increase of electrocoagulation efficiency. The addition of H_2O_2 has positive effect on COD removal only above 563.31mg/L.

At this stage, significant differences of flocs settling velocity are observed and the variation of flocs settling velocity with the dosage of H_2O_2 is shown in the Fig. S2. In a reversal trends with electrocoagulation efficiency, the fastest settling velocity of flocs is obtained at 563.31mg/L H_2O_2 concentration. The experiments prove that excessive settling velocity may result in low COD removal efficiency. The experimental phenomenon after 6 hours sedimentation is shown in the insert graph. It is evident that the height of final boundary between mud and water also show a decline first followed by a upswing.

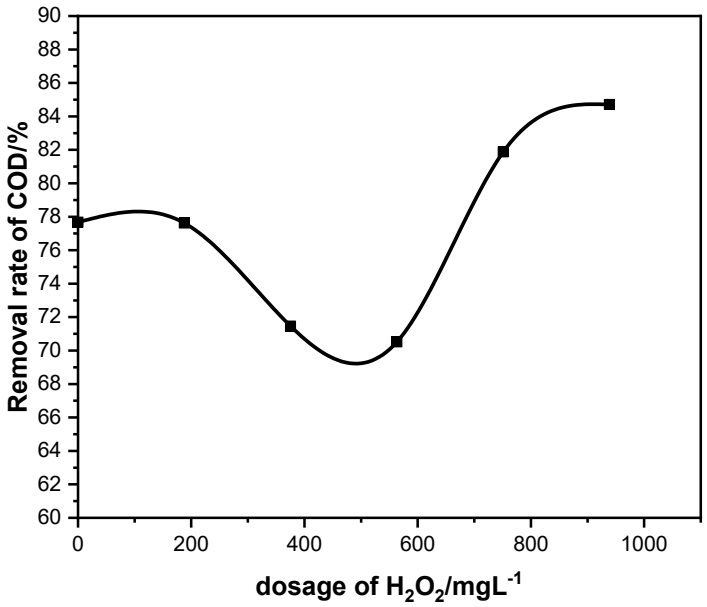

Fig S1. Variation of COD removal rate with dosage of H_2O_2 (Anode material: Fe, Cathode material: Stainless steel, Current density: 19.23 mA/cm^2, pH: 3.0, Electrolysis time: 70 min).

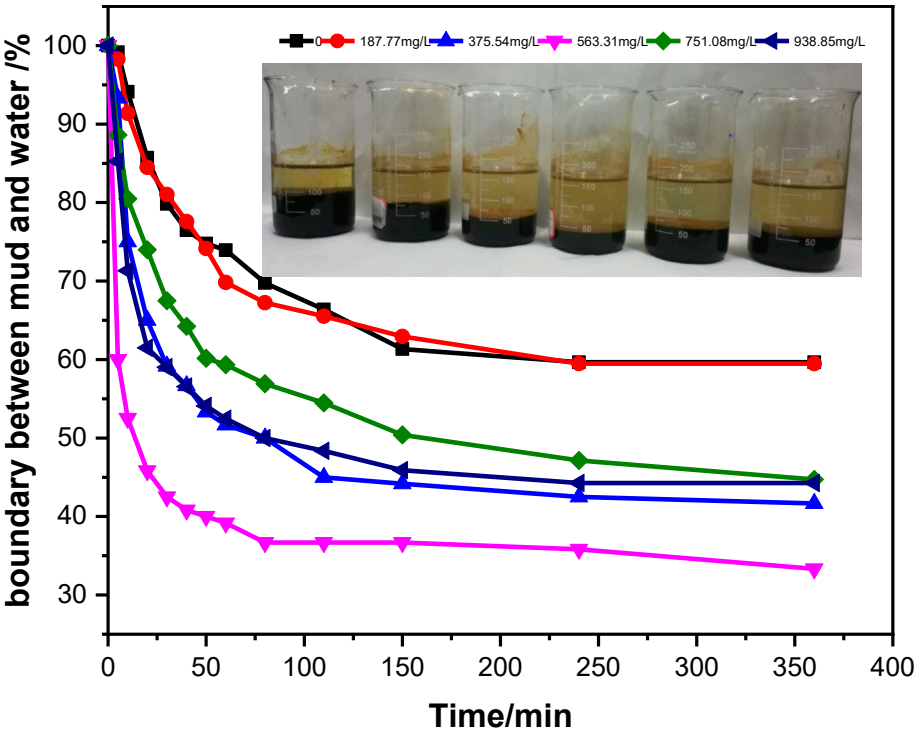

Fig S2. Effect of H_2O_2 on the boundary between mud and water.

Table S1. Flotation tests results with fresh water

Product	Weight (g)	Yield (%)	Recovery (%)		Grade (%)	
			Pb	Zn	Pb	Zn
Pb concentrate	13.51	1.80	30.54	0.21	71.73	0.84
midding 1	27.11	3.62	40.76	0.96	47.71	1.89
midding 2	9.96	1.33	3.87	1.00	12.33	5.36
midding 3	53.12	7.09	10.63	5.85	6.35	5.89
midding 4	22.46	3.00	3.36	2.82	4.74	6.73
Zn concentrate	64.46	8.60	1.52	68.61	0.75	56.96
midding 5	29.7	3.96	2.52	13.41	2.69	24.17
midding 6	31.72	4.23	1.67	0.87	1.67	1.47
midding 7	31.01	4.14	1.90	3.47	1.94	5.99
tailing	466.57	62.24	3.23	2.79	0.22	0.32
total	749.62	100.00	100.00	100.00		

Table S2. Flotation tests results with mixed wastewater

Product	Weight (g)	Yield (%)	Recovery (%)		Grade (%)	
			Pb	Zn	Pb	Zn
Pb concentrate	13.73	1.83	25.01	0.35	57.62	1.37
midding 1	41.02	5.46	53.36	1.84	41.14	2.42
midding 2	9.21	1.23	1.57	1.06	5.39	6.2
midding 3	47.52	6.32	4.54	5.60	3.02	6.36
midding 4	34.58	4.60	6.83	3.97	6.25	6.2
Zn concentrate	56.85	7.56	1.17	59.99	0.65	56.96
midding 5	14.19	1.89	0.73	4.53	1.62	17.24
midding 6	36.52	4.86	1.87	1.67	1.62	2.47
midding 7	35.76	4.76	1.71	15.60	1.51	23.54
tailing	462.15	61.49	3.21	5.39	0.22	0.63
total	751.53	100.00	100.00	100.00		

Table S3. Flotation tests results with treated water

Product	Weight (g)	Yield (%)	Recovery (%)		Grade (%)	
			Pb	Zn	Pb	Zn
Pb concentrate	21.08	2.82	36.06	0.47	51.91	1.21
midding 1	44.04	5.89	48.85	2.67	33.66	3.26
midding 2	11.91	1.59	1.35	1.52	3.45	6.88
midding 3	42.64	5.71	3.55	5.00	2.53	6.31
midding 4	19.02	2.55	2.19	2.49	3.5	7.04
Zn concentrate	62.47	8.36	0.66	65.33	0.32	56.33
midding 5	22.67	3.03	1.40	11.68	1.88	27.75
midding 6	26.82	3.59	1.10	0.94	1.24	1.89
midding 7	26.73	3.58	1.43	4.85	1.62	9.77
tailing	469.93	62.88	3.41	5.06	0.22	0.58
total	747.31	100.00	100.00	100.00		

References

1. Yüksel E, S¸EngiL IA, Özacar M. The removal of sodium dodecyl sulfate in synthetic wastewater by peroxi-electrocoagulation method. *Chemical Engineering Journal* **2009**;*152*, 347-53.
2. Nidheesh PV, Gandhimathi R. Trends in electro-Fenton process for water and wastewater treatment: An overview. *Desalination* **2012**; 299, 1-15.