

Supplementary Material

Supplementary material 1. Papers selected in this meta-analysis

- Yan, Y., Qi, F., Zhao, S., Luo, Y., Gu, S., Li, Q., Zhang, L., Zhou, S., Bolan, N. (2019) A new low-cost hydroxyapatite for efficient immobilization of lead. *Journal of Colloid and Interface Science*, 553, 798-804.
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Supplementary Table.S1-1 Heavy metal stabilisation efficiency of different material after different particle size separation

			Stabilisation efficiency (%)					
			Calcium salt	Phosphate	Organic matter	Clay mineral	Biochar	Other
As	Size≤0.15mm	25% quantile						
		Median						
		mean				74.23		
		75% quantile						
		n				1		
	Size0.15~2mm	25% quantile						
		Median						
		mean		53.00				5.20
		75% quantile						
		n		1				1
	Size≥2mm	25% quantile	7.19		19.47	13.95	16.01	32.14
		Median	12.37		33.64	24.07	62.97	71.88
		mean	41.44		51.44	31.06	54.02	60.77
		75% quantile	99.84		92.32	42.27	86.06	87.02
		n	23		5	20	14	12
Size≤0.15mm	25% quantile				43.11			
	Median				62.43			
	mean	60.87			58.38			
	75%				71.94			

		quantile						
		n	1			6		
	Size0.15~2mm	25% quantile	39.09		34.93	3.25		63.87
		Median	66.38		71.18	5.38		82.87
		mean	59.85	46.00	67.23	6.08		78.14
		75% quantile	79.35		100	9.61		90.05
		n	9	1	6	3		5
	Size≥2mm	25% quantile	10.69	13.06	12.46	12.80	21.74	34.85
		Median	33.66	27.12	29.35	25.37	35.47	57.94
		mean	44.93	35.63	36.59	29.61	40.67	53.45
		75% quantile	83.33	60.56	54.04	43.35	59.11	82.55
n		90	45	17	101	145	44	
Cr	Size≤0.15mm	25% quantile						
		Median				13.51		
		mean				13.51		
		75% quantile						
		n				2		
	Size0.15~2mm	25% quantile						
		Median						
		mean						
		75% quantile						
		n						
	Size≥2mm	25% quantile					29.11	
		Median	45.51				52.00	
		mean	45.51				53.92	81.71
		75% quantile					79.65	
		n	2				17	1
Cu	Size≤0.15mm	25% quantile				13.09		
		Median				20.69		
		mean	29.29			23.25		
		75% quantile				32.51		
		n	1			17		
	Size0.15~2mm	25% quantile						
		Median	55.53					
		mean	55.53					
		75% quantile						
		n	2					
	Size≥2mm	25% quantile	20.00	16.00	7.73	9.75	23.23	19.74
		Median	86.44	32.57	16.27	16.15	43.11	42.24
		mean	64.32	37.32	27.86	19.51	42.95	46.89
		75%	95.01	60.93	46.16	29.25	62.53	85.00
		n	1	1	1	1	1	1

		quantile						
		n	12	27	23	21	84	23
Mn	Size \leq 0.15mm	25% quantile						
		Median						
		mean						
		75% quantile						
		n						
	Size0.15~2mm	25% quantile						
		Median						
		mean						
		75% quantile						
		n						
	Size \geq 2mm	25% quantile					12.09	
		Median					22.42	
		mean				53.57	19.96	
		75% quantile					25.37	
		n				1	3	
Ni	Size \leq 0.15mm	25% quantile				29.33		
		Median				32.00		
		mean	32.00			37.78		
		75% quantile				52.00		
		n	1			3		
	Size0.15~2mm	25% quantile						
		Median						
		mean	67.62					
		75% quantile						
		n	1					
	Size \geq 2mm	25% quantile	32.03	0.67	12.18	39.53	18.68	48.00
		Median	55.91	1.83	14.54	48.84	30.62	67.8
		mean	51.21	2.98	19.57	46.10	34.41	69.18
		75% quantile	65.70	6.43	32.00	60.47	56.77	96.3
		n	4	4	4	7	7	11
Pb	Size \leq 0.15mm	25% quantile		98.74		5.67		
		Median		99.41		10.31		
		mean	15.53	98.95		15.26		
		75% quantile		99.67		16.67		
		n	1	25		29		
	Size0.15~2mm	25% quantile	88.44					32.40
		Median	98.13					85.37
		mean	92.82	43.3				68.81
		75%	99.63					98.71
		n	1	1				1

		quantile						
		n	10	1				15
	Size \geq 2mm	25% quantile	15.61	33.55	11.47	14.53	14.63	23.55
		Median	49.33	62.00	18.46	27.52	28.81	58.20
		mean	52.98	57.41	20.00	34.25	35.37	56.93
		75% quantile	97.80	82.97	29.33	55.62	50.51	91.24
n		121	73	32	50	91	67	
Sb	Size \leq 0.15mm	25% quantile						
		Median						
		mean						
		75% quantile						
		n						
	Size0.15~2mm	25% quantile						
		Median						
		mean						
		75% quantile						
		n						
	Size \geq 2mm	25% quantile					9.64	
		Median	0				18.07	12.65
		mean	0				20.02	12.65
		75% quantile					32.35	
		n	1				3	2
Zn	Size \leq 0.15mm	25% quantile				16.07		
		Median				19.63		
		mean	38.17			25.95		
		75% quantile				41.04		
		n	1			17		
	Size0.15~2mm	25% quantile						95.76
		Median						98.17
		mean	46.15					97.38
		75% quantile						99.05
		n	1					8
	Size \geq 2mm	25% quantile	92.88	19.33	7.01	19.43	22.27	24.00
		Median	100	41.88	20.60	31.04	51.37	40.87
		mean	95.02	43.50	20.90	41.04	53.04	40.90
		75% quantile	100	70.71	37.42	65.74	83.20	59.00
		n	15	20	11	17	47	11

Supplementary Table.S1-2 Heavy metal unit stabilisation efficiency of different material after different particle size separation

			Unit stabilisation efficiency (%/%)					
			Calcium salt	Phosphate	Organic matter	Clay mineral	Biochar	Other
As	Size≤0.15m m	25% quantile						
		Median						
		mean				74.23		
		75% quantile						
		n				1		
	Size0.15~2m m	25% quantile						
		Median						
		mean		13.25				1.08
		75% quantile						
		n		1				1
	Size≥2mm	25% quantile	2.47		8.45	13.85	0.39	14.7
		Median	4.99		18.59	22.96	2.10	23.3
		mean	6.56		19.57	25.37	2.97	26.0
		75% quantile	7.99		31.18	31.76	5.96	38.1
		n	23		5	20	14	12
Cd	Size≤0.15m m	25% quantile				10.93		
		Median				18.84		
		mean	20.29			28.28		
		75% quantile				39.34		
		n	1			6		
	Size0.15~2m m	25% quantile	5.96		48.33	10.83		2.66
		Median	6.89		50.00	48.03		2.92
		mean	7.06	11.50	59.46	37.54		4.38
		75% quantile	8.19		80.20	53.75		6.83
		n	9	1	6	3		5
	Size≥2mm	25% quantile	5.89	6.38	16.18	5.40	6.45	6.20
		Median	11.88	12.46	29.79	13.33	11.00	14.76
		mean	23.91	30.89	38.25	24.88	14.61	27.91
		75% quantile	20.53	30.03	51.89	37.95	16.14	38.56
		n	90	45	10	101	145	44
Cr	Size≤0.15m m	25% quantile						
		Median						
		mean						

	Size0.15~2mm	75% quantile							
		n							
		25% quantile							
		Median				4.50			
		mean				4.50			
	Size≥2mm	75% quantile							
		n				2			
		25% quantile					8.64		
		Median	22.38				14.45		
		mean	22.38				18.63	40.86	
	Cu	Size≤0.15mm	75% quantile						
			n	2				17	1
			25% quantile				4.96		
			Median				7.82		
			mean	9.76			9.62		
Size0.15~2mm		75% quantile				11.66			
		n	1			17			
		25% quantile							
		Median	11.11						
		mean	11.11						
Size≥2mm		75% quantile							
		n	2						
		25% quantile	3.74	6.92	7.31	5.81	7.19	10.26	
		Median	8.92	12.31	9.47	8.00	11.31	19.73	
		mean	20.73	42.60	10.32	9.99	24.13	44.63	
Mn	Size≤0.15mm	75% quantile	15.47	38.15	12.26	9.59	15.70	54.76	
		n	12	27	23	21	84	23	
		25% quantile							
		Median							
		mean							
	Size0.15~2mm	75% quantile							
		n							
		25% quantile							
		Median							
		mean							
	Size≥2mm	25% quantile					4.23		
		Median					5.60		
		mean				133.93	5.29		

		75% quantile					6.04		
		n				1	3		
Ni	Size \leq 0.15m m	25% quantile				9.78			
		Median				10.67			
		mean	10.67			12.59			
		75% quantile				17.33			
		n	1			3			
	Size0.15~2m m	25% quantile							
		Median							
		mean	13.52						
		75% quantile							
		n	1						
	Size \geq 2mm	25% quantile	11.08	0.40	3.69	10.23	7.42	17.30	
		Median	16.82	1.18	8.57	16.28	11.35	47.38	
		mean	17.37	1.90	9.75	18.15	10.53	59.17	
		75% quantile	24.22	4.15	16.98	24.13	11.76	97.31	
		n	4	4	4	7	7	11	
Pb	Size \leq 0.15m m	25% quantile		24.82		5.67			
		Median		33.22		10.31			
		mean	5.18	44.99		15.26			
		75% quantile		49.67		16.67			
		n	1	25		29			
	Size0.15~2m m	25% quantile	7.64					3.27	
		Median	11.54					3.30	
		mean	13.35	10.83				35.61	
		75% quantile	18.46					32.40	
		n	10	1				15	
	Size \geq 2mm	25% quantile	4.59	9.95	4.50	4.73	7.20	10.31	
		Median	10	19.78	8.10	8.78	13.33	17.83	
		mean	13.77	38.47	13.81	13.84	17.77	20.61	
		75% quantile	19.81	37.58	14.95	22.15	24.39	21.39	
		n	121	73	32	50	91	67	
Sb	Size \leq 0.15m m	25% quantile							
		Median							
		mean							
		75% quantile							
		n							
	Size0.15~2m m	25% quantile							
		Median							
mean									

	Size \geq 2mm	75% quantile						
		n						
		25% quantile					1.92	
		Median	0				3.61	
		mean	0				4.00	126.51
		75% quantile					6.47	126.51
		n	1			3	2	
Zn	Size \leq 0.15mm	25% quantile				4.44		
		Median				9.38		
		mean	12.72			9.88		
		75% quantile				16.03		
		n	1			17		
	Size 0.15~2mm	25% quantile						1.57
		Median						1.63
		mean	9.23					2.23
		75% quantile						3.30
		n	1					8
	Size \geq 2mm	25% quantile	10.00	7.62	1.75	4.44	7.37	2.90
		Median	18.58	12.84	4.12	10.19	16.40	3.81
		mean	19.30	11.63	11.74	16.46	20.67	8.46
		75% quantile	35.77	15.31	19.64	22.46	22.60	6.18
		n	15	20	11	17	47	11



Supplementary Figure S1: Statistics of hot words on heavy metal stabilisation from 2008 to 2024. TS = (heavy metal AND Stabilisation AND material).