

Development of Short-term Exposure Water Quality Standards for Cd, Cu, Pb and Zn in China (Supplementary materials)

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Table S1. Acute toxicity of Cd²⁺ to aquatic animals

Rank	SMAVs/(μg/L)	Species Group	Scientific Name	References
1	1.40	Fish	<i>Salmo trutta</i>	[1]
2	13.1	Cladoceran	<i>Simocephalus serrulatus</i>	/
3	19.0	Shrimp	<i>Macrobrachium nipponnensic</i>	[2]
4	20.0	Amphipoda	<i>Gammarus pulex</i>	[3]
5	39.1	Cladoceran	<i>Daphnia magna</i>	/
6	40.1	Amphipoda	<i>Gammarus lacustris</i>	[4]
7	54.8	Cladoceran	<i>Ceriodaphnia dubia</i>	/
8	70.0	Rotifer	<i>Brachionus calyciflorus</i>	[5]
9	71.3	Cladoceran	<i>Moina macrocopa</i>	[6]
10	79.8	Asellota	<i>Asellus aquaticus</i>	/
11	80.0	Snail	<i>Physa fontinalis</i>	[3]
12	106	Cladoceran	<i>Daphnia pulex</i>	/
13	110	Cladoceran	<i>Ceriodaphnia reticulata</i>	/
14	115	Gray hydra	<i>Hydra vulgaris</i>	/
15	120	Copepod	<i>Eurytemora affinis</i>	[7]
16	210	Hydra	<i>Hydra viridissima</i>	[8]
17	280	Fish	<i>Aristichthys nobilis</i>	/
18	320	Hydra	<i>Hydra oligactis</i>	[8]
19	400	Midge (larvae)	<i>Chironomus plumosus</i>	[9]
20	546	Cladoceran	<i>Alona affinis</i>	[10]
21	580	Cladoceran	<i>Daphnia obtusa</i>	[11]
22	651	Cladoceran	<i>Daphnia carinata</i>	/
23	748	Goldfish	<i>Carassius auratus</i>	[12]
24	780	Annelid	<i>Lumbriculus variegatus</i>	[13]
25	1679	Annelid	<i>Tubifex tubifex</i>	/

26	1810	Hydra	<i>Hydra pseudoligactis</i>	[14]
27	2400	Annelid	<i>Limnodrilus hoffmeisteri</i>	[15]
28	2423	Fish	<i>Ctenopharyngodon idellus</i>	/
29	2821	Tadpole	<i>Rana limnochari</i>	/
30	3100	Tadpole	<i>Rana nigromaculata</i>	[16]
31	3390	Mollusc	<i>Bellamya purificata</i>	[17]
32	3453	Crab	<i>Eriocheir sinensis</i>	/
33	3802	Fish	<i>Cyprinus carpio</i>	/
34	4440	Fish	<i>Megalobrama pellegrini</i>	[18]
35	4447	Fish	<i>Tanichthys albonubes</i>	[19]
36	4560	Fish	<i>Cyprinus carpio</i> var	[20]
37	6294	Fish	<i>Pseudorasbora parva</i>	[21]
38	6500	Fish	<i>Gasterosteus aculeatus</i>	[22]
39	7463	Tadpole	<i>Bufo bufogargarizans</i>	/
40	10170	Crab	<i>Sinopotamon henanense</i>	[23]
41	12240	Fish	<i>Gobiocypris rarus</i>	[24]
42	19400	Fish	<i>Channa striata</i>	[25]
43	55375	Midge (larvae)	<i>Prosilocerus akamusi</i>	[26]
44	56500	Fish	<i>Misgurnus anguillicaudatus</i>	[27]
45	58020	Annelid	<i>Branchiura sowerbyi</i>	[28]

“/” indicate that the SMAV value is geometric mean of several acute values, and the literatures are not shown. (the same as following tables).

Table S2. Acute toxicity of Cu²⁺ to aquatic animals

Rank	SMAV/ (µg/L)	Species Group	Scientific Name	References
1	0.16	Annelid	<i>Tubifex tubifex</i>	[29]
2	4.52	Cladoceran	<i>Ceriodaphnia pulchella</i>	/
3	4.61	Cladoceran	<i>Ceriodaphnia dubia</i>	/
4	5.30	Cladoceran	<i>Scapholeberis mucronata</i>	[30]
5	6.11	Cladoceran	<i>Daphnia longispina</i>	/
6	8.50	Cladoceran	<i>Daphnia galeata</i>	/
7	8.74	Cladoceran	<i>Simocephalus exspinosus</i>	/
8	9.20	Cladoceran	<i>Bosmina longirostris</i>	[30]
9	10.8	Cladoceran	<i>Ceriodaphnia reticulata</i>	/
10	12.9	Cladoceran	<i>Acroperus harpae</i>	/
11	15.4	Cladoceran	<i>Chydorus sphaericus</i>	/
12	17.0	Cladoceran	<i>Daphnia obtusa</i>	[11]
13	17.7	Cladoceran	<i>Eurycercus lamellatus</i>	/
14	17.9	Cladoceran	<i>Chydorus ovalis</i>	/
15	18.0	Fish	<i>Pseudorasbora parva</i>	[31]
16	18.5	Fish	<i>Misgurnus mizolepis</i>	/
17	19.8	Rotifer	<i>Brachionus calyciflorus</i>	/

18	24.6	Cladoceran	<i>Daphnia carinata</i>	/
19	26.0	Tadpole	<i>Rana nigromaculata</i>	[32]
20	28.2	Cladoceran	<i>Alona quadrangularis</i>	[30]
21	31.0	Fish	<i>Hypophthalmichthys molitrix</i>	[33]
22	34.6	Cladoceran	<i>Ceriodaphnia quadrangula</i>	[34]
23	37.0	Amphipoda	<i>Gammarus pulex</i>	[35]
24	39.0	Fish	<i>Acipenser sinensis</i>	/
25	39.0	Fish	<i>Ctenopharyngodon idellus</i>	[33]
26	39.0	Fish	<i>Tanichthys albonubes</i>	[19]
27	42.0	Hydra	<i>Hydra vulgaris</i>	[36]
28	43.3	Cladoceran	<i>Disparalona rostrata</i>	[30]
29	44.3	Cladoceran	<i>Daphnia pulex</i>	/
30	45.0	Cladoceran	<i>Daphnia magna</i>	/
31	60.0	Rotifer	<i>Lecane luna</i>	[37]
32	90.0	Fish	<i>Carassius auratus</i>	[38]
33	100	Fish	<i>Aristichthys nobilis</i>	[39]
34	102	Tadpole	<i>Rana japonica</i>	[40]
35	144	Fish	<i>Cyprinus carpio</i>	/
36	152	Fish	<i>Cyprinus carpio var.</i>	/
37	208	Tadpole	<i>Rana limnocharis</i>	/
38	212	Amphipoda	<i>Gammarus lacustris</i>	[4]
39	220	Crab	<i>Eriocheir sinensis</i>	[41]
40	230	Fish	<i>Megalobrama pellegrini</i>	[18]
41	236	Fish	<i>Rhodens sinensis</i>	[42]
42	240	Mollusc	<i>Bellamyia aeruginosa</i>	[43]
43	273	Tadpole	<i>Bufo bufogargarizans</i>	/
44	277	Ostracod	<i>Cypris subglobosa</i>	[44]
45	362	Shrimp	<i>Macrobrachium nipponense</i>	[45]
46	369	Fish	<i>Spinibarbus sinensis</i>	/
47	382	Mollusc	<i>Bellamyia purificata</i>	[17]
48	530	Midge (larvae)	<i>Chironomus plumosus</i>	[46]
49	724	Fish	<i>Rhodeus ocellatus</i>	[47]
50	779	Flatworm	<i>Dugesia japonica</i>	[48]
51	1120	Amphibian	<i>Eurycea bislineata</i>	[49]
52	2170	Tadpole	<i>Rana chensinensis</i>	[50]
53	14180	Crab	<i>Sesarma dehaani</i>	[51]
54	28610	Crab	<i>Sinopotamon henanense</i>	[23]

Table S3. Acute toxicity of Pb²⁺ to aquatic animals

Rank	SMAV/ (µg/L)	Species Group	Scientific Name	References
1	63.8	Cladoceran	<i>Ceriodaphnia dubia</i>	/
2	170	Fish	<i>Cyprinus carpio</i>	[52]
3	175	Amphipoda	<i>Gammarus pulex</i>	[53]
4	257	Cladoceran	<i>Daphnia magna</i>	[54]
5	320	Fish	<i>Thymallus arcticus</i>	[55]
6	440	Fish	<i>Cyprinus carpio</i>	[56]

7	444	Cladoceran	<i>Daphnia carinata</i>	[57]
8	600	Cladoceran	<i>Daphnia hyalina</i>	[58]
9	630	Fish	<i>Aristichthys nobilis</i>	[39]
10	755	Cladoceran	<i>Moina macrocopa</i>	[59]
11	1318	Cladoceran	<i>Ceriodaphnia reticulata</i>	/
12	1745	Cladoceran	<i>Daphnia pulex</i>	/
13	8000	Annelid	<i>Lumbriculus variegatus</i>	[13]
14	10130	Hydra	<i>Hydra pseudoligactis</i>	[60]
15	13228	Fish	<i>Rhodeus ocellatus</i>	[47]
16	14620	Annelid	<i>Tubifex tubifex</i>	[61]
17	33280	Amphibian	<i>Rana hexadactyla</i>	[62]
18	36930	Crab	<i>Eriocheir sinensis</i>	[63]
19	40000	Fish	<i>Carassius auratus</i>	[64]
20	58400	Fish	<i>Channa striata</i>	[25]
21	64100	Asellota	<i>Asellus aquaticus</i>	[65]
22	105000	Fish	<i>Heteropneustes fossilis</i>	[66]
23	273900	Fish	<i>Carassius auratus</i>	[27]
24	294500	Fish	<i>Misgurnus anguil licaudatus</i>	[27]
25	576412	Fish	<i>Ctenopharyngodon idellus</i>	[67]
26	692090	Crab	<i>Sinopotamon henanense</i>	[23]

Table S4 Acute toxicity of Zn²⁺ to aquatic animals

Rank	SMAV/ (µg/L)	Species Group	Scientific Name	References
1	85.4	Cladoceran	<i>Ceriodaphnia reticulata</i>	/
2	107	Cladoceran	<i>Daphnia pulex</i>	[68]
3	124	Cladoceran	<i>Ceriodaphnia dubia</i>	/
4	192	Cladoceran	<i>Daphnia magna</i>	/
5	260	Rotifer	<i>Brachionus calyciflorus</i>	[69]
6	357	Cladoceran	<i>Moina macrocopa</i>	[70]
7	375	Cladoceran	<i>Daphnia longispina</i>	[71]
8	450	Fish	<i>Cyprinus carpio</i>	[72]
9	911	Cladoceran	<i>Simocephalus exspinosus</i>	[71]
10	1000	Cladoceran	<i>Daphnia carinata</i>	[73]
11	1001	Cladoceran	<i>Daphnia galeata</i>	[71]
12	1326	Cladoceran	<i>Chydorus sphaericus</i>	[71]
13	1627	Cladoceran	<i>Chydorus ovalis</i>	[71]
14	2240	Amphipoda	<i>Gammarus lacustris</i>	[4]
15	4090	Cladoceran	<i>Eurytemora affinis</i>	[74]
16	9500	Midge (larvae)	<i>Chironomus plumosus</i>	[9]
17	10130	Fish	<i>Spinibarbus sinensis</i>	[75]
18	11000	Hydra	<i>Hydra viridissima</i>	[36]
19	13000	Hydra	<i>Hydra vulgaris</i>	[36]
20	13780	Fish	<i>Ctenopharyngodon idellus</i>	/
21	17861	Fish	<i>Rhodeus ocellatus</i>	[76]
22	30760	Tadpole	<i>Bufo bufogargarizans</i>	[77]
23	30800	Fish	<i>Misgurnus anguil licaudatus</i>	[27]

24	32131	Fish	<i>Carassius auratus</i>	/
25	46500	Tadpole	<i>Rana limnocharis Boie</i>	[78]
26	70000	Amphibian	<i>Rana catesbeiana</i>	[79]

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