

Supplementary Material

Table S 1. Inhalable, Thoracic and Respirable Fractions in Concrete Chipping Work

Hazards	Impactor Stage No.	Effectiveness	Concrete Chipping						Total Stage Conc./Total Impactor Conc.	Average Inhalable Fraction	Average Thoracic Fraction	Average Respirable Fraction	Concrete Chipping		
			Sampled Concentration(Conc.) (mg/m3)			Corrected Concentration(Conc.) (mg/m3)							Inhalable	Thoracic	Respirable
			#1	#2	#3	#1	#2	#3							
Dust	1	0.52	10.48	3.66	11.53	20.15	7.03	22.17	0.42	0.567	0.008	0.000	0.24	0.00	0.00
	2	0.61	8.42	2.07	6.87	13.81	3.40	11.26	0.24	0.670	0.102	0.000	0.16	0.02	0.00
	3	0.78	4.12	2.27	7.53	5.29	2.92	9.65	0.15	0.740	0.337	0.005	0.11	0.05	0.00
	4	0.89	2.52	1.43	5.53	2.84	1.61	6.22	0.09	0.812	0.670	0.065	0.07	0.06	0.01
	5	0.95	0.86	0.70	4.80	0.90	0.74	5.05	0.06	0.876	0.861	0.361	0.05	0.05	0.02
	6	0.96	0.44	0.42	2.89	0.45	0.44	3.01	0.03	0.930	0.930	0.819	0.03	0.03	0.03
	7	0.97	0.00	0.20	0.76	0.00	0.20	0.79	0.01	0.964	0.964	0.963	0.01	0.01	0.01
	8	0.99	0.00	0.02	0.00	0.00	0.02	0.00	0.00	0.979	0.979	0.979	0.00	0.00	0.00
	F	1.00	0.09	0.07	0.21	0.09	0.07	0.21	0.00	0.992	0.992	0.992	0.00	0.00	0.00
	Sum					43.52	16.44	58.36	1.00					0.674	0.230
Silica	1	0.52	0.15	0.10	0.16	0.28	0.19	0.32	0.24	0.567	0.008	0.000	0.14	0.00	0.00
	2	0.61	0.15	0.12	0.13	0.25	0.20	0.22	0.21	0.670	0.102	0.000	0.14	0.02	0.00
	3	0.78	0.12	0.08	0.18	0.15	0.11	0.23	0.15	0.740	0.337	0.005	0.11	0.05	0.00
	4	0.89	0.17	0.06	0.17	0.19	0.06	0.19	0.14	0.812	0.670	0.065	0.11	0.09	0.01
	5	0.95	0.13	0.05	0.15	0.14	0.05	0.16	0.11	0.876	0.861	0.361	0.09	0.09	0.04
	6	0.96	0.13	0.04	0.14	0.14	0.04	0.15	0.10	0.930	0.930	0.819	0.09	0.09	0.08
	7	0.97	0.05	0.01	0.03	0.05	0.01	0.03	0.03	0.964	0.964	0.963	0.03	0.03	0.03
	8	0.99	0.03	0.01	0.01	0.03	0.01	0.01	0.02	0.979	0.979	0.979	0.02	0.02	0.02
	F	1.00	0.01	0.00	0.00	0.01	0.00	0.00	0.01	0.992	0.992	0.992	0.01	0.01	0.01
	Sum					1.24	0.68	1.31	1.00					0.739	0.402

Table S 2. Inhalable, Thoracic and Respirable Fractions in Concrete Grinding Work

Hazards	Impactor Stage No.	Effectiveness	Concrete Grinding						Total Stage Conc./Total Impactor Conc.	Average Inhalable Fraction	Average Thoracic Fraction	Average Respirable Fraction	Concrete Grinding		
			Sampled Concentration(Conc.) (mg/m3)			Corrected Concentration(Conc.) (mg/m3)							Inhalable	Thoracic	Respirable
			#1	#2	#3	#1	#2	#3							
Dust	1	0.52	11.37	25.81	5.93	21.86	49.63	11.40	0.37	0.567	0.008	0.000	0.21	0.00	0.00
	2	0.61	9.05	13.68	9.97	14.83	22.43	16.34	0.24	0.670	0.102	0.000	0.16	0.02	0.00
	3	0.78	9.01	11.36	6.01	11.55	14.56	7.70	0.15	0.740	0.337	0.005	0.11	0.05	0.00
	4	0.89	7.70	11.20	3.68	8.65	12.59	4.14	0.11	0.812	0.670	0.065	0.09	0.08	0.01
	5	0.95	5.44	6.74	3.22	5.73	7.09	3.39	0.07	0.876	0.861	0.361	0.06	0.06	0.03
	6	0.96	3.17	3.61	1.11	3.30	3.76	1.16	0.04	0.930	0.930	0.819	0.03	0.03	0.03
	7	0.97	1.26	0.65	0.32	1.30	0.67	0.33	0.01	0.964	0.964	0.963	0.01	0.01	0.01
	8	0.99	0.06	0.00	0.00	0.06	0.00	0.00	0.00	0.979	0.979	0.979	0.00	0.00	0.00
	F	1.00	0.32	0.40	0.21	0.32	0.40	0.21	0.00	0.992	0.992	0.992	0.00	0.00	0.00
	Sum						67.60	111.13	44.66	1.00				0.687	0.266
Silica	1	0.52	0.17	0.32	0.08	0.32	0.62	0.16	0.18	0.567	0.008	0.000	0.10	0.00	0.00
	2	0.61	0.20	0.31	0.16	0.33	0.50	0.26	0.18	0.670	0.102	0.000	0.12	0.02	0.00
	3	0.78	0.28	0.39	0.15	0.36	0.50	0.19	0.17	0.740	0.337	0.005	0.13	0.06	0.00
	4	0.89	0.30	0.51	0.14	0.33	0.58	0.16	0.17	0.812	0.670	0.065	0.14	0.12	0.01
	5	0.95	0.26	0.45	0.15	0.27	0.48	0.16	0.15	0.876	0.861	0.361	0.13	0.13	0.05
	6	0.96	0.19	0.29	0.07	0.20	0.30	0.08	0.09	0.930	0.930	0.819	0.09	0.09	0.08
	7	0.97	0.07	0.12	0.02	0.08	0.13	0.02	0.04	0.964	0.964	0.963	0.04	0.04	0.04
	8	0.99	0.02	0.05	0.01	0.02	0.05	0.01	0.01	0.979	0.979	0.979	0.01	0.01	0.01
	F	1.00	0.02	0.02	0.00	0.02	0.02	0.00	0.01	0.992	0.992	0.992	0.01	0.01	0.01
	Sum						1.94	3.18	1.04	1.00				0.760	0.463

Table S 3. Cumulative probability graph formula and mass median diameter of respirable dust

Job	Sample	Cumulative probability graph formula		Mass median diameter (Cumulative probability 50% diameter)	
		Respirable dust	Respirable Crystalline Silica	Respirable dust	Respirable Crystalline Silica
Concrete Chipping	#1	$y = 4.4197x - 3.9448$	$y = 4.6447x + 7.2745$	12.206 μm	9.198 μm
	#2	$y = 4.4784x - 1.4026$	$y = 4.7037x + 0.0399$	11.477 μm	10.621 μm
	#3	$y = 4.5591x + 0.0392$	$y = 4.7634x + 5.097$	10.958 μm	9.426 μm
Concrete Grinding	#4	$y = 4.633x + 1.528$	$y = 4.8639x + 7.6436$	10.462 μm	8.708 μm
	#5	$y = 4.4416x - 0.9722$	$y = 4.8058x + 7.5818$	11.476 μm	8.826 μm
	#6	$y = 4.8272x - 2.5319$	$y = 4.972x + 4.1777$	10.882 μm	9.216 μm

The Cumulative probability graph formula is equation of the size distribution of respirable dust and respirable crystalline silica in concrete chipping and grinding as expressed in Figure 6. Sample means the sample collected with Anderson cascade impactor. Mass median diameter means the diameter of respirable dust and respirable crystalline

Table S 4. Crystalline silica proportion (%) of sampled dust in each impactor stage

Stage No.	Cut-Point Diameter (μm)	Crystalline silica proportion (%) of sampled dust							
		Concrete Chipping				Concrete Grinding			
		Sample # 1	Sample # 2	Sample # 3	Mean \pm SD	Sample # 1	Sample # 2	Sample # 3	Mean \pm SD
1	21.3	1.302	2.531	1.383	1.74 \pm 0.69	1.39	1.19	1.38	1.32 \pm 0.11
2	14.8	1.683	5.580	1.866	3.04 \pm 2.20	2.12	2.05	1.53	1.90 \pm 0.32
3	9.8	2.473	3.389	2.292	2.72 \pm 0.59	2.92	3.10	2.33	2.79 \pm 0.40
4	6	5.206	3.600	2.870	3.89 \pm 1.19	3.58	4.13	3.54	3.75 \pm 0.33
5	3.5	8.127	5.557	3.022	5.57 \pm 2.55	4.27	5.68	4.50	4.81 \pm 0.75
6	1.55	11.390	7.213	4.340	7.65 \pm 3.54	5.11	5.957	5.46	5.51 \pm 0.43
7	0.93	11.974	2.951	2.858	5.93 \pm 5.24	4.04	6.38	4.29	4.90 \pm 1.28
8	0.52	8.390	6.385	3.672	6.15 \pm 2.37	3.74	7.65	8.84	6.74 \pm 2.67
B	Backup Filter	1.260	0.978	0.861	1.03 \pm 0.21	1.66	1.08	0.73	1.16 \pm 0.47

※SD: Standard Deviation

Table S 5. Previous studies reported on the RCS concentration in construction sites

Construction Type	Job(Task)	n	RCS Concentration(mg/m ³)			Country	Reference
			AM(±SD)	GM (GSD)	Range		
Apartment complex	Concrete chipping	36	0.32±0.60	0.12(4.13)	0.005~3.06	S.Korea	This study
	Concrete grinding	58	3.54±3.67	2.06(3.23)	0.10~17.62		
	Plastering	35	0.006±0.006	0.003(2.86)	n.d~0.027		
General Building	Recess millers	53	1.43	0.7 (3.3)	N.D. ~ 6.9	Netherlands	Lumens M et al., 2001
	Inner wall constructors	36	0.06	0.04 (2.6)	N.D. ~ 0.2		
	Demolition workers	82	2.88	1.1 (4.0)	N.D. ~ 35.9		
General Building	Recess Miller/concrete work	14	1.09	0.42 (5.0)	0.036 ~ 4.7	Netherlands (1999)	Tjoe E et al., 2003
	Tuck pointers	10	0.56	0.35 (2.8)	0.089 ~ 1.6		
	Demolition workers	21	0.25	0.14 (2.7)	0.038 ~ 1.3		
	Innerwall construction	4	0.043	0.036 (2.0)	0.016 ~ 0.084		
	Construction site cleaner	12	0.032	0.017 (3.6)	0.0016 ~ 0.0097		
Office Building	clean up	11	-	0.03 (2.79)	-	United States (2000-2001)	Flanagan ME et al., 2003
	Hans demolition	14	-	0.10 (2.60)	-		
	Concrete cutting	15	-	0.07 (2.78)	-		
	Concrete mixing	9	-	0.02 (1.99)	-		
	Tuck point grinding	12	-	0.22 (1.94)	-		
	Surface grinding	23	-	0.63 (4.12)	-		
	Sack and patch concrete	13	-	0.03 (2.22)	-		
Various construction site	Painter and painter blaster	14	Median 1.28	-	0.260 ~ 26.2	United States (1992-2000)	Rappaport SM et al., 2003
	Bricklayer	11	Median 0.32	-	0.007 ~ 14.2		
	Operating engineer	46	Median 0.075	-	0.007 ~ 0.8		
	Laborer and drill runner	80	Median 0.35	-	0.007 ~ 5.9		
Highway construction (asphalt pavement milling)	Operator_A site	11	0.0071	0.0062(2.02)	Max 0.013	United States	Hammond D et al., 2016
	Ground worker_A site	11	0.0066	0.0061(1.72)	MAx 0.010		
	Operator_B site	10	0.0048	0.0042(1.90)	Max 0.011		
	Ground worker_B site	10	0.0098	0.0090(1.90)	Max 0.024		