APPENDIX B

CONCENTRATIONS OF RESPIRABLE COAL MINE DUST AND RESPIRABLE CRYSTALLINE SILICA IN SAMPLES REQUIRED BY 30 CFR 90

Table B–1. Summary of respirable coal mine dust samples collected under 30 CFR 90 by MSHA inspectors for underground occupations, 1988–92*

MSHA code and occupation	Number of samples	Concentration of respirable coal mine dust (mg/m^3)				Percentage of samples				
		Arithmetic mean	SD	Geometric mean	GSD	≤0.5 mg/m^3	≤1.0 mg/m^3	≤1.5 mg/m^3	≤2.0 mg/m^3	>2.0 mg/m^3
019 Roof bolter mounted (intake)	1	3.80	——	3.80	——	0	0	0	0	100
046 Roof bolter	5	1.66	0.38	1.62	1.28	0	0	40	100	0
002 Electrician	11	0.97	0.75	0.77	2.07	36	64	82	91	9
269 Motorman	48	0.79	0.69	0.56	2.41	50	67	94	96	4
053 Utility man	5	0.78	0.22	0.75	1.34	20	100	100	100	0
001 Belt man/conveyor man	6	0.77	0.37	0.66	1.94	33	83	100	100	0
116 Laborer	173	0.77	0.67	0.57	2.27	47	80	92	97	3
016 Laborer	8	0.76	0.86	0.52	2.36	63	88	88	88	13
050 Shuttle car operator (on side)	5	0.74	0.28	0.69	1.52	40	100	100	100	0
109 Supply man	32	0.71	0.64	0.54	2.12	53	78	94	97	3
049 Section foreman	10	0.70	0.69	0.45	2.82	60	80	90	90	10
101 Belt man/conveyor man	23	0.66	0.36	0.53	2.19	43	87	100	100	0

See footnote at end of table.

(Continued)

Table B–1 (Continued). Summary of respirable coal mine dust samples collected under 30 CFR 90 by MSHA inspectors for underground occupations, 1988–92*

MSHA code and occupation	Number of samples	Concentration of respirable coal mine dust (mg/m^3)				Percentage of samples				
		Arithmetic mean	SD	Geometric mean	GSD	≤0.5 mg/m^3	≤1.0 mg/m^3	≤1.5 mg/m^3	≤2.0 mg/m^3	>2.0 mg/m^3
035 Continuous miner helper	9	0.61	0.33	0.51	2.04	33	100	100	100	0
004 Mechanic	14	0.60	0.32	0.51	1.94	57	93	100	100	0
154 Belt cleaner, belt picker	10	0.60	0.50	0.39	2.97	50	80	100	100	0
108 Mason stopping builder, ventilation man	6	0.58	0.51	0.41	2.63	67	83	100	100	0
149 Bullgang foreman, labor foreman	1	0.50	——	0.50	——	100	100	100	100	0
102 Electrician	23	0.41	0.35	0.30	2.21	78	91	100	100	0
110 Timberman	7	0.40	0.35	0.30	2.24	86	86	100	100	0
111 Wireman	1	0.40	——	0.40	——	100	100	100	100	0
263 Track foreman	1	0.40	——	0.40	——	100	100	100	100	0
122 Coal dump operator	3	0.37	0.15	0.34	1.61	100	100	100	100	0
104 Mechanic	26	0.28	0.17	0.23	1.91	96	100	100	100	0
414 Dust sampler	4	0.28	0.29	0.19	2.50	75	100	100	100	0
009 Supply man	1	0.20	——	0.20	——	100	100	100	100	0
418 Maintenance foreman	3	0.20	0.17	0.16	2.23	100	100	100	100	0
216 Trackman	2	0.15	0.07	0.14	1.63	100	100	100	100	0

(Continued)

Table B–1 (Continued). Summary of respirable coal mine dust samples collected under 30 CFR 90 by MSHA inspectors for underground occupations, 1988–92*

MSHA code and occupation	Number of samples	Concentration of respirable coal mine dust (mg/m^3)				Percentage of samples				
		Arithmetic mean	SD	Geometric mean	GSD	≤0.5 mg/m^3	≤1.0 mg/m^3	≤1.5 mg/m^3	≤2.0 mg/m^3	>2.0 mg/m^3
430 Assistant mine foreman/ assistant mine manager	2	0.15	0.07	0.14	1.63	100	100	100	100	0
221 Hoistman	1	0.10	——	0.10	——	100	100	100	100	0
265 Dispatcher	2	0.10	0.00	0.10	1.00	100	100	100	100	0
462 Fireboss, preshift examiner	2	0.10	0.00	0.10	1.00	100	100	100	100	0
999 Summary for valid occupations	445	0.69	0.62	0.48	2.38	55	82	94	97	3

*Concentrations are based on a sampling flow rate of 2.0 L/min and use of the MRE conversion factor of 1.38.

Table B–2. Summary of respirable coal mine dust samples collected under 30 CFR 90 by mine operators for underground occupations, 1988–92*

MSHA code and occupation	Number of samples	Concentration of respirable coal mine dust (mg/m^3)				Percentage of samples				
		Arithmetic mean	SD	Geometric mean	GSD	≤0.5 mg/m^3	≤1.0 mg/m^3	≤1.5 mg/m^3	≤2.0 mg/m^3	>2.0 mg/m^3
019 Roof bolter mounted (intake)	13	4.76	7.60	0.88	8.45	46	54	62	62	38
012 Roof bolter (twin head-intake)	4	1.30	0.62	1.13	2.01	25	25	50	100	0
035 Continuous miner helper	10	1.22	0.91	0.87	2.72	30	40	80	80	20
430 Assistant mine foreman/ assistant mine manager	40	1.15	1.55	0.45	4.05	60	73	75	83	18
008 Mason, stopping builder, ventilation man	5	1.12	0.41	1.07	1.40	0	60	80	100	0
046 Roof bolter	13	0.95	0.40	0.86	1.72	15	62	92	100	0
114 Coal sampler	5	0.88	0.36	0.82	1.50	20	60	100	100	0
049 Section foreman	31	0.83	0.51	0.70	1.79	35	77	94	94	6
050 Shuttle car operator (on side)	33	0.82	0.64	0.58	2.50	48	70	82	97	3
108 Mason, stopping builder, ventilation man	72	0.78	1.61	0.40	2.80	69	82	93	94	6
154 Belt cleaner, belt picker	47	0.76	0.82	0.41	3.32	55	72	85	94	6
122 Coal dump operator	17	0.71	0.40	0.58	2.09	47	76	100	100	0
116 Laborer	688	0.69	0.97	0.44	2.55	59	83	93	97	3
110 Timberman	65	0.66	0.68	0.42	2.59	63	82	89	95	5
016 Laborer	38	0.63	0.92	0.33	2.94	68	87	89	92	8

See footnote at end of table.

(Continued)

Table B–2 (Continued). Summary of respirable coal mine dust samples collected under 30 CFR 90 by mine operators for underground occupations, 1988–92*

MSHA code and occupation	Number of samples	Concentration of respirable coal mine dust (mg/m^3)				Percentage of samples				
		Arithmetic mean	SD	Geometric mean	GSD	≤0.5 mg/m^3	≤1.0 mg/m^3	≤1.5 mg/m^3	≤2.0 mg/m^3	>2.0 mg/m^3
156 Rock driller	8	0.60	0.19	0.57	1.40	50	100	100	100	0
101 Belt man/conveyor man	72	0.54	0.58	0.34	2.60	69	89	96	96	4
002 Electrician	33	0.52	0.31	0.43	1.92	64	94	100	100	0
109 Supply man	51	0.50	0.31	0.40	2.05	71	92	100	100	0
149 Bullgang foreman/labor foreman	8	0.49	0.34	0.38	2.23	75	88	100	100	0
104 Mechanic	190	0.46	0.43	0.33	2.26	77	92	97	99	1
004 Mechanic	66	0.43	0.31	0.32	2.21	76	94	100	100	0
102 Electrician	105	0.34	0.39	0.23	2.26	86	94	99	99	1
157 Pumper	5	0.34	0.18	0.29	2.02	100	100	100	100	0
269 Motorman	75	0.34	0.21	0.28	1.89	88	99	100	100	0
216 Trackman	16	0.31	0.29	0.23	2.18	88	94	100	100	0
053 Utility man	6	0.30	0.39	0.19	2.53	83	83	100	100	0
462 Fireboss, preshift examiner	13	0.19	0.10	0.17	1.65	100	100	100	100	0
414 Dust sampler	22	0.15	0.09	0.13	1.55	100	100	100	100	0
999 Summary for valid occupations	1,751	0.64	1.10	0.39	2.60	66	85	94	97	3

*Concentrations are based on a sampling flow rate of 2.0 L/min and use of the MRE conversion factor of 1.38.

Table B–3. Summary of respirable coal mine dust samples collected under 30 CFR 90 by MSHA inspectors for surface occupations, 1988–92*

MSHA code and occupation	Number of samples	Concentration of respirable coal mine dust (mg/m^3)				Percentage of samples				
		Arithmetic mean	SD	Geometric mean	GSD	≤0.5 mg/m^3	≤1.0 mg/m^3	≤1.5 mg/m^3	≤2.0 mg/m^3	>2.0 mg/m^3
398 Groundman	1	0.60	——	0.60	——	0	100	100	100	0
380 Fine coal plant operator	4	0.55	0.13	0.54	1.27	50	100	100	100	0
341 Beltman/conveyor man	29	0.44	0.46	0.29	2.40	79	90	97	97	3
304 Mechanic	22	0.40	0.32	0.29	2.32	77	91	100	100	0
321 Hoist engineer/operator	1	0.40	——	0.40	——	100	100	100	100	0
374 Cleaning plant operator	10	0.37	0.18	0.33	1.77	90	100	100	100	0
386 Refuse truck driver	9	0.36	0.31	0.26	2.31	89	89	100	100	0
313 Cleanup man	2	0.35	0.21	0.32	1.91	100	100	100	100	0
316 Laborer, blacksmith	43	0.35	0.39	0.23	2.39	79	95	98	100	0
368 Bulldozer operator	6	0.35	0.35	0.23	2.68	83	100	100	100	0
392 Tipple operator	6	0.33	0.15	0.29	1.85	100	100	100	100	0
318 Greaser, oiler	2	0.30	0.14	0.28	1.63	100	100	100	100	0
373 Car dropper	3	0.30	0.17	0.25	2.23	100	100	100	100	0
394 Carpenter	1	0.30	——	0.30	——	100	100	100	100	0
395 Water truck operator	1	0.30	——	0.30	——	100	100	100	100	0
382 Highlift operator	7	0.24	0.11	0.22	1.75	100	100	100	100	0

*See footnote at end of table

(Continued)

Table B–3 (Continued). Summary of respirable coal mine dust samples collected under 30 CFR 90 by MSHA inspectors for surface occupations, 1988–92*

MSHA code and occupation	Number of samples	Concentration of respirable coal mine dust (mg/m^3)				Percentage of samples				
		Arithmetic mean	SD	Geometric mean	GSD	≤0.5 mg/m^3	≤1.0 mg/m^3	≤1.5 mg/m^3	≤2.0 mg/m^3	>2.0 mg/m^3
328 Utility man	15	0.22	0.17	0.18	1.85	93	100	100	100	0
309 Supply man	7	0.21	0.09	0.20	1.49	100	100	100	100	0
343 Car trimmer/car loader	4	0.20	0.14	0.17	1.94	100	100	100	100	0
369 Motorman	2	0.20	0.14	0.17	2.17	100	100	100	100	0
385 Lampman	33	0.19	0.12	0.16	1.78	100	100	100	100	0
314 Coal sampler	5	0.18	0.04	0.17	1.36	100	100	100	100	0
365 Dispatcher	14	0.18	0.17	0.14	1.87	93	100	100	100	0
319 Welder, (shop) blacksmith	2	0.15	0.07	0.14	1.63	100	100	100	100	0
999 Summary for valid occupations	229	0.31	0.30	0.23	2.13	88	97	99	100	0

*Concentrations are based on a sampling flow rate of 2.0 L/min and use of the MRE conversion factor of 1.38.

Table B–4. Summary of respirable coal mine dust samples collected under 30 CFR 90 by mine operators for surface occupations, 1988–92*

MSHA code and occupation	Number of samples	Concentration of respirable coal mine dust (mg/m^3)				Percentage of samples				
		Arithmetic mean	SD	Geometric mean	GSD	≤0.5 mg/m^3	≤1.0 mg/m^3	≤1.5 mg/m^3	≤2.0 mg/m^3	>2.0 mg/m^3
341 Beltman/conveyor man	87	0.55	2.14	0.19	2.56	94	95	97	97	3
374 Cleaning plant operator	104	0.55	0.41	0.40	2.42	57	83	98	100	0
380 Fine coal plant operator	28	0.52	0.36	0.39	2.32	68	93	100	100	0
392 Tipple operator	14	0.50	0.21	0.46	1.48	71	100	100	100	0
304 Mechanic	57	0.48	0.37	0.35	2.30	63	93	98	100	0
386 Refuse truck driver	42	0.45	0.97	0.25	2.47	88	95	98	98	2
343 Car trimmer/car loader	24	0.35	0.22	0.28	2.06	79	100	100	100	0
314 Coal sampler	32	0.30	0.60	0.17	2.31	94	94	97	97	3
365 Dispatcher	85	0.23	0.19	0.17	1.99	94	100	100	100	0
368 Bulldozer operator	21	0.23	0.18	0.18	1.91	95	100	100	100	0
373 Car dropper	41	0.23	0.24	0.17	2.03	88	98	100	100	0
313 Cleanup man	25	0.22	0.13	0.19	1.81	100	100	100	100	0
321 Hoist engineer/operator	20	0.22	0.13	0.18	1.79	100	100	100	100	0
398 Groundman	6	0.22	0.24	0.16	2.20	83	100	100	100	0
379 Dryer operator	22	0.20	0.10	0.18	1.64	100	100	100	100	0
385 Lampman	140	0.20	0.30	0.15	1.90	95	99	99	99	1

See footnote at end of table.

(Continued)

Table B–4 (Continued). Summary of respirable coal mine dust samples collected under 30 CFR 90 by mine operators for surface occupations, 1988–92*

MSHA code and occupation	Number of samples	Concentration of respirable coal mine dust (mg/m^3)				Percentage of samples				
		Arithmetic mean	SD	Geometric mean	GSD	≤0.5 mg/m^3	≤1.0 mg/m^3	≤1.5 mg/m^3	≤2.0 mg/m^3	>2.0 mg/m^3
316 Laborer, blacksmith	112	0.19	0.16	0.16	1.85	96	100	100	100	0
382 Highlift operator	16	0.19	0.10	0.16	1.76	100	100	100	100	0
328 Utility man	33	0.18	0.20	0.14	1.81	94	97	100	100	0
369 Motorman	7	0.17	0.11	0.15	1.73	100	100	100	100	0
309 Supply man	33	0.16	0.10	0.14	1.61	100	100	100	100	0
394 Carpenter	3	0.10	0.00	0.10	1.00	100	100	100	100	0
999 Summary for valid occupations	952	0.32	0.74	0.20	2.25	87	96	99	99	1

*Concentrations are based on a sampling flow rate of 2.0 L/min and use of the MRE conversion factor of 1.38.

Table B–5. Summary of respirable crystalline silica samples collected under 30 CFR 90 by MSHA coal mine inspectors for underground occupations, 1988–92*

MSHA code and occupation	Number of samples	Concentration of respirable crystalline silica (mg/m^3)				Percentage of samples		
		Arithmetic mean	SD	Geometric mean	GSD	≤0.058 $mg/m^{3\dagger}$	≤0.100 $mg/m^{3\ddagger}$	>0.100 mg/m^3
019 Roof bolter mounted (intake)	1	2.68	——	2.68	——	0	0	100
046 Roof bolter	1	0.38	——	0.38	——	0	0	100
109 Supply man	5	0.13	0.21	0.06	3.47	80	80	20
154 Belt cleaner, belt picker	4	0.07	0.11	0.02	4.59	75	75	25
269 Motorman	7	0.06	0.03	0.05	1.71	57	86	14
035 Continuous miner helper	2	0.05	0.04	0.05	2.22	50	100	0
050 Shuttle car operator (on side)	2	0.05	0.01	0.05	1.17	100	100	0
101 Belt man/conveyor man	8	0.04	0.03	0.03	2.26	75	88	13
002 Electrician	1	0.02	——	0.02	——	100	100	0
016 Laborer	2	0.02	0.01	0.01	2.17	100	100	0
108 Mason stopping builder, ventilation man	1	0.02	——	0.02	——	100	100	0
116 Laborer	30	0.02	0.03	0.02	2.42	97	97	3
004 Mechanic	1	0.01	——	0.01	——	100	100	0
102 Electrician	2	0.01	0.01	0.00	5.09	100	100	0
110 Timberman	1	0.01	——	0.01	——	100	100	0
001 Belt man/conveyor man	1	0.00	——	0.00	——	100	100	0

See footnotes at end of table.

(Continued)

Table B–5 (Continued). Summary of respirable crystalline silica samples collected under 30 CFR 90 by MSHA coal mine inspectors for underground occupations, 1988–92*

MSHA code and occupation	Number of samples	Concentration of respirable crystalline silica (mg/m^3)				Percentage of samples		
		Arithmetic mean	SD	Geometric mean	GSD	≤0.058 mg/m^3†	≤0.100 mg/m^3‡	>0.100 mg/m^3
999 Summary for valid occupations	69	0.08	0.33	0.02	3.58	84	90	10

*Concentrations are based on a sampling flow rate of 2.0 L/min and use of the MRE conversion factor of 1.38.

†0.058 is equivalent to the NIOSH REL of 0.050 mg/m^3, which is based on a sampling flow rate of 1.7 L/min and no use of the MRE conversion factor.

‡MSHA PEL.

Table B–6. Summary of respirable crystalline silica samples collected under 30 CFR 90 by MSHA coal mine inspectors for surface occupations, 1988–92*

MSHA code and occupation	Number of samples	Concentration of respirable crystalline silica (mg/m^3)				Percentage of samples		
		Arithmetic mean	SD	Geometric mean	GSD	≤0.058 $mg/m^{3\dagger}$	≤0.100 $mg/m^{3\ddagger}$	>0.100 mg/m^3
382 Highlift operator	1	0.03	——	0.03	——	100	100	0
304 Mechanic	4	0.02	0.01	0.02	1.92	100	100	0
374 Cleaning plant operator	1	0.01	——	0.01	——	100	100	0
380 Fine coal plant operator	1	0.01	——	0.01	——	100	100	0
316 Laborer, blacksmith	2	0.00	0.00	0.00	1.00	100	100	0
341 Beltman/conveyor man	1	0.00	——	0.00	——	100	100	0
999 Summary for valid occupations	10	0.01	0.01	0.01	4.00	100	100	0

*Concentrations are based on a sampling flow rate of 2.0 L/min and use of the MRE conversion factor of 1.38.

†0.058 is equivalent to the NIOSH REL of 0.050 mg/m^3, which is based on a sampling flow rate of 1.7 L/min and no use of the MRE conversion factor.

‡MSHA PEL.

APPENDIX C

OPTIONAL DUST CONTROL TECHNIQUES FOR COAL MINING ENVIRONMENTS

The following sections list optional dust control techniques for various types of mining (conventional, auger-type continuous, continuous miner-type, and longwall), for underground areas outby mining sections, and for preparation plants.

C.1 CONVENTIONAL MINING

Hollow-steel, drilling-auger-based, dry dust collection systems for face drills [Chander et al. 1988]

Hollow-steel, drilling-auger-based, water suppression systems for face drills [Chander et al. 1988]

Water-filled dummies for stemming shotholes to reduce dust in coal breaking [Cummins and Given 1973]

External cutter bar sprays machine-mounted at the front and rear of the cutter bar on cutting machines [Kost et al. 1981]

External sprays mounted on loading machines near the gathering arms on the pan and directed at the conveyor [Kost et al. 1981]

Cardox® (liquified carbon dioxide), Airdox® (compressed air), or Hydrox® (sodium nitrate and ammonium chloride reaction) chemical and hydraulic coal burster systems for high pressure breakage of face coals [Bourgoyne et al. 1986]

Low porosity line brattice with tight top and bottom seals for single-split and double-split ventilation systems [Kost et al. 1981]

Double-split ventilation systems to keep extraction and roof bolting activities in separate fresh air currents [Kost et al. 1981]

Improved stopping-construction techniques using mortar supplemented with steel or fiberglass fibers brushed on as sealant coatings [Kost et al. 1981]

Machine-mounted water spray systems to (1) wet coal surfaces to immobilize dust and prevent it from becoming airborne, and (2) generate water droplets to collide with and engulf airborne dust particles accelerating settlement from the airstream [Kost et al. 1981]

Upgraded water supply systems incorporating increased pump capacity for additional flow and pressure with increased line sizes to decrease pressure losses [Shirey et al. 1985; Jankowski and Organiscak 1983; Kost et al. 1981]

"Non-clogging" filtration system that uses hydrocyclone, flushable Y-strainer, and micropolishing filter devices to improve water quality and reduce maintenance downtime [Shirey et al. 1985; Jankowski and Organiscak 1983; Kost et al. 1981]

Haulroads that have been wet, with calcium chloride applied to maintain moisture content and minimize airborne dust in intake airstreams [Kost et al. 1981]

Belt scrapers, installed on the return side of the belt near the drive, for cleaning the load-bearing side of the belt [Shirey et al. 1985; Organiscak et al. 1986; Kost et al. 1981]

C.2 AUGER-TYPE CONTINUOUS MINING

Double-split ventilation systems to keep extraction and roof-bolting activities in separate fresh air currents [Kost et al. 1981]

Combination line brattice plus auxiliary fan face ventilation systems for improved continuous face ventilation [Kost et al. 1981]

Improved stopping-construction techniques using mortar supplemented with steel or fiberglass fibers brushed on as sealant coatings [Kost et al. 1981]

Machine-mounted external water spray systems to (1) wet coal surfaces to immobilize dust and prevent it from becoming airborne, and (2) generate water droplets to collide with and engulf airborne dust particles accelerating settlement from the airstream [Kost et al. 1981]

Wet-auger water spray systems supplying nozzles on the auger shaft and at cutting bits for dust suppression [Kost et al. 1981]

Upgraded water supply systems incorporating increased pump capacity for additional flow and pressure with increased line sizes to decrease pressure losses [Shirey et al. 1985; Jankowski and Organiscak 1983; Kost et al. 1981]

"Non-clogging" filtration system that uses hydrocyclone, flushable Y-strainer, and micropolishing filter devices to improve water quality and reduce maintenance downtime [Shirey et al. 1985; Jankowski and Organiscak 1983; Kost et al. 1981]

Nonionic surfactant additives and wetting agents for improved performance of water-spray, dust-suppression systems [Chander et al. 1988; Kost et al. 1981]

Machine-mounted, high-pressure, water-powered scrubber for reducing dusts on blowing ventilation systems [Campbell 1988; Bourgoyne et al. 1986]

Haulroads that have been wet with water, with calcium chloride applied to maintain moisture content and minimize airborne dust in intake airstreams [Kost et al. 1981]

Belt scrapers, installed on the return side of the belt near the drive, for cleaning the load-bearing side of the belt [Shirey et al. 1985; Organiscak et al. 1986; Kost et al. 1981]

C.3 CONTINUOUS MINER-TYPE MINING

Double-split ventilation systems to keep extraction and roof bolting activities in separate fresh air currents [Kost et al. 1981]

Combination line brattice plus auxiliary fan face ventilation systems for improved continuous face ventilation [Kost et al. 1981]

Blowing diffuser fans mounted on the continuous miner opposite the exhaust tubing or brattice to sweep dust into the exhaust ventilation system [Kost et al. 1981]

Improved stopping-construction techniques using mortar supplemented with steel or fiberglass fibers brushed on as sealant coatings [Kost et al. 1981]

Large bits (conical and others) used on drum-type continuous miners and operation at reduced speed to break the coal out in larger chunks and reduce dust generation [Cummins and Given 1973]

Machine-mounted water spray systems that use additional sprays or improved mounting positions to (1) wet coal surfaces to immobilize dust and prevent it from becoming airborne, and (2) generate water droplets to collide with and engulf airborne dust particles accelerating settlement from the airstream [Kost et al. 1981]

Continuous miner-mounted conveyor throat venturi sprays to prevent dispersion of dust clouds into the operator's station [Kost et al. 1981]

Machine-mounted, high-pressure, water-powered scrubber for dust collection [Kost et al. 1981]

Nonionic surfactant additives and wetting agents for improved performance of water-spray, dust-suppression systems [Chander et al. 1988; Shirey et al. 1985; Kost et al. 1981]

Continuous miner-mounted venturi scrubber and ducting systems for dust capture and removal [Jayaraman 1979]

Upgraded water supply systems incorporating increased pump capacity for additional flow and pressure with increased line sizes to decrease pressure losses [Shirey et al. 1985; Jankowski and Organiscak 1983; Kost et al. 1981]

"Non-clogging" filtration system that uses hydrocyclone, flushable Y-strainer, and micropolishing filter devices to improve water quality and reduce maintenance downtime [Shirey et al. 1985; Jankowski and Organiscak 1983; Kost et al. 1981]

Remote control operation systems for continuous miners to keep operators out of the zone of dust production [Cummins and Given 1973]

Half-curtain, face-ventilation techniques to redirect dusts [Jayaraman et al. 1988]

High-pressure, shrouded, water sprays mounted on continuous miner cutting head [Jayaraman et al. 1981]

Campbell flooded bed scrubber systems installed on the continuous miner [Campbell 1988; Frantz and Ramani 1988]

Twin-flooded, fibrous-bed scrubber and water droplet eliminator systems [Divers et al. 1981; Kost et al. 1981]

Auxiliary ventilation tubing on the exhaust of face ventilation fans to reroute dust from the continuous miner past downstream roof bolter working places directly into return entries [Babbitt and Jayaraman 1988]

Roof-bolter, flooded-bed scrubber and fan modules that receive a split of dusty air from the continuous miner, extracts the respirable dust, and delivers it to the roof bolters as a split of fresh air [Babbitt and Jayaraman 1988]

Wet drilling with or without water-jet-assisted cutting in roof bolting operations [Adam 1990]

Belt scrapers, installed on the return side of the belt near the drive, for cleaning the load-bearing side of the belt [Shirey et al. 1985; Organiscak et al. 1986; Kost et al. 1981; Barrett et al. 1983]

Machine-mounted, high-pressure, water-powered scrubber [Campbell 1988]

Venturi scrubbers and ceramic flow-through filters for particulate emission control on diesel powered equipment [Wheeler 1986]

Haulroads that have been wet, with calcium chloride applied to maintain moisture content and minimize airborne dust in intake airstreams [Kost et al. 1981]

Short-hole water infusion from horizontal holes drilled into the working face to a depth equal to the daily advance of the face to increase the moisture content of the coal [Kost et al. 1981]

Long-hole water infusion holes drilled parallel into the coal seam in advance of the face and before extraction to increase the moisture content of the coal [Shirey et al. 1985; Cervik et al. 1983; Taylor and Evans 1985; Taylor et al. 1986; Kost et al. 1981]

C.4 LONGWALL MINING

Increased ventilation air quantity and face velocities for increased dust dilution [Shirey et al. 1985]

Longwall-shearer remote controls for operators [Shirey et al. 1985]

Computer-controlled systems for automated advancement of roof support systems from a direction downwind of the shearer or plow [Shirey et al. 1985; Organiscak et al. 1985]

Water sprays directed over shield and chock roof support canopies to suppress dust generated during support movement [Jankowski and Organiscak 1983; Organiscak et al. 1985]

Large bits (conical and others) used on drum-type shearer and operation at reduced drum rotational speed to break the coal out in larger chunks and reduce dust generation [Cummins and Given 1973]

Deep-cut-shearer cutting drums with lower drum rotational speeds [Shirey et al. 1985]; Shearer-Clearer external water spray system using high-pressure, air-moving water sprays to confine shearer-generated dust near the face and away from operators [Shirey et al. 1985; Jankowski and Organiscak 1983; Jayaraman et al. 1985]

Splitter-arm, passive belting barriers [Shirey et al. 1985; Jankowski and Organiscak 1983; Jankowski and Babbitt 1986; Jayaraman et al. 1985]

Machine cooling water relocated into panline sprays or a crescent spray ring wrapped around shearer ranging arms [Shirey et al. 1985; Jayaraman et al. 1985]

Alternate-design mining sequence taking the primary face cut downwind with operators positioned upwind ahead of the lead cutting drum [Shirey et al. 1985; Jankowski and Organiscak 1983; Organiscak et al. 1985]

Special fabricated shearer cutting drums incorporating cavity filling, water-through-the-bit, and pick-face flushing sprays [Shirey et al. 1985]

Upgraded water supply systems incorporating increased pump capacity for additional flow and pressure with increased line sizes to decrease pressure losses [Shirey et al. 1985; Jankowski and Organiscak 1983]

Installation of a "non-clogging" filtration system utilizing hydrocyclone, flushable Y-strainer, and microfilter devices to improve water quality and reduce maintenance downtime [Shirey et al. 1985; Jankowski and Organiscak 1983]

Ventilation curtains (wing curtain, gob curtain, and stage loader curtain) used in the headgate area to minimize air leakage into the gob and reduce the shearer operator's dust exposure when cutting out at the headgate [Shirey et al. 1985; Jankowski and Organiscak 1983; Organiscak et al. 1986]

Stageloader and crusher enclosed with steel plates or strips of conveyor belting to isolate conveyed material from the airstream and reduce dust entrainment [Shirey et al. 1985; Jankowski and Organiscak 1983; Organiscak et al. 1986]

Spraybars containing multiple full-cone water sprays mounted in the stageloader/crusher and at the stageloader-belt conveyor transfer point to provide uniform coverage of the coal stream [Shirey et al. 1985; Jankowski and Organiscak 1983; Organiscak et al. 1986]

A water-powered scrubber and brattice partition to reduce tailgate worker's dust exposure [Shirey et al. 1985; Organiscak et al. 1983]

Belt scrapers, installed on the return side of the belt near the drive, for cleaning the load-bearing side of the belt [Shirey et al. 1985; Organiscak et al. 1986; Kost et al. 1981]

High-pressure, water-jet-assisted cutting for shearers [Taylor et al. 1986]

Nonionic surfactant additives and wetting agents for enhanced performance of water-spray, dust-suppression systems [Chander et al. 1988; Shirey et al. 1985]

Water infusion holes drilled into the coal seam before extraction to increase the moisture content of the coal [Shirey et al. 1985; Cervik et al. 1983; Taylor and Evans 1985; Taylor et al. 1986]

C.5 UNDERGROUND AREAS OUTBY MINING SECTIONS

Water sprinkled on empty coal cars, the tops of loaded cars, and coal on conveyor belts to reduce or eliminate dust blown into ventilating airstreams [Cummins and Given 1973]

A water-powered scrubber at belt conveyor transfer points to capture and eliminate dusts suspended in the airstream [Shirey et al. 1985; Organiscak et al. 1983]

Filter cartridge-based compact dry dust collectors for dust control at transfer points and airlock stations [Barrett et al. 1983]

C.6 SURFACE OPEN PIT MINING

Steel-collar-vacuum dust collection systems drilled with cyclones and baghouses for drill units [Gadomski and Chiz 1988]

Water-based or oil-based wet drilling techniques to eliminate dusts generated during shothole drilling and reduce dusts during subsequent rock and coal breakage [Cummins and Given 1973; Bourgoyne et al. 1986]

Environmentally-controlled, airtight cab enclosures for highwall rotary blasthole drill units and bulldozers [Gadomski and Chiz 1988; Frantz and Ramani 1988]

Trucks equipped with water sprays optionally using wetting agents for roadway and haulroad dust control [Cummins and Given 1973]

Wood-based adhesive polymer foam for roadway dust and materials handling [Charlton 1988]

Building conveyors with elevated discharge chutes around a steel tube with discharge windows at appropriate intervals, or the use of telescopic chutes to materially cut blowage of dusts [Cummins and Given 1973]

C.7 PREPARATION PLANTS

Nonionic surfactant additives for water-spray, dust-suppression systems at conveyor transfer points, crushers, and vibrating screens [Zimmer et al. 1988]

Overhead air supplied island (OASIS) for operators and maintenance personnel at stationary locations [Volkwein et al. 1988; Frantz and Ramani 1988]

Airtight enclosures around transfer chutes with and without local exhaust systems to control suspended dusts [Cummins and Given 1973]

Airtight housings and hoods with vacuum fans and dust collectors or electrostatic precipitators to clean up dusts at rotary breakers, raw coal screens, and crushers [Cummins and Given 1973; Divers and Cecala 1990; Divers and Jankowski 1988]

A water-powered scrubber at belt conveyor transfer points to capture and eliminate dusts suspended in the airstream [Shirey et al. 1985; Organiscak et al. 1983; Divers and Cecala 1990]

Prepared coal confined in storage bins or silos to prevent dust dispersal [Cummins and Given 1973]

Building conveyors with elevated discharge chutes around a steel tube with discharge windows at appropriate intervals, or the use of telescopic chutes to materially cut blowage of dusts [Cummins and Given 1973]

Sprayed storage piles of fine, prepared coal that will stand for appreciable times with fuel oil to reduce dust blowage [Cummins and Given 1973]

C.8 OTHER DUST EXPOSURE CONTROL OPTIONS

Within the hierarchy of dust control technologies, all available engineering controls should be implemented first. During implementation periods, or after exhausting engineering technologies, two additional dust exposure mediation techniques may be instituted:

1. Use of administrative controls (i.e., rotating workers from high dust-making operations to low dust-making operations to expose the mine personnel to lower average daily dust concentrations) [Barrett et al. 1983]

2. Use of respirators capable of removing respirable-size particulates (which are commercially available from a number of suppliers and may be provided to miners with proper training in their use and maintenance) [Barrett et al. 1983; Divers and Cecala 1990]

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