Dust Controls on Surface Mine Drilling Operations

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ABSTRACT

Studies were conducted on drills at surface coal mines throughout the United States. The objective was to determine impact of controls on respirable dust and silica exposure.

Respirable dust and silica concentrations were measured inside and outside the drill cabs. Variables such as cab pressurization filtration systems, external dust collectors, filter types, and cab volumes were also ascertained.

Figure 1. Sampling Configuration.

CALCULATIONS

Concentration (time weighted average) =

$$\frac{\text{Mass (mg)} \times 1000\ (\text{L/m}^3) \times 1.38\ (\text{MRE equivalent})}{\text{2.0 Lpm} \times \text{Time (min)}}$$

Concentration reduction percentages =

$$\frac{[\text{Conc. outside (mg/m}^3) - \text{Conc.Inside(mg/m}^3)] \times 100}{\text{Concentration outside (mg/m}^3)}$$

All respirable and total dust samples were analyzed for quartz by infrared spectroscopy (Method P-7).

CONCLUSIONS AND RECOMMENDATIONS

1. The skirt should be touching the ground to provide a dust capture hood.

2. The external dust collection systems need to be properly designed and maintained.

3. Environmental cabs should be pressurized with filtered intake and recirculated air to reduce operator exposure to respirable dust and silica

4. Reductions in cab respirable dust and quartz as high as 99 percent were observed in properly maintained and operated systems.

5. At cab pressure differentials above 0.2 inches of water gage, inside respirable dust concentration was generally reduced by more than 75 percent.

6. The quartz content of the respirable dust outside the cabs ranged from 4 to 71 percent, depending on the type of overburden being drilled.

7. Percent quartz inside the cab was generally less than percent quartz outside the cab.

8. The percent reduction in quartz concentration was the same or greater than the reduction in respirable dust.

9. Cabs should be sealed and windows and doors kept closed so that the only air entering the cab is the filtered intake air used to pressurize the cab.

10. Filters should be replaced when cab pressure drops by 50 percent or if visual inspection of filter indicates damage to filter integrity.

11. Cabs should be kept clean by either wet wiping or vacuuming the interior on a regular basis.

Table 1. Highwall Drill equipment information.

Mine	Manufacturer	Model	Ext. Dust Collector	Table Shroud	Pressurizer	Filter Type	Recirc. Unit	Filter Type	Cab Vol. cu. ft.
A	Reedrill	SKF-45	FC4500	Yes	AC/Heater	Standard	Frigette	Standard	153
B	Ingersoll Rand	DML	FC	Yes	Red Dot	Standard	Frigette	Standard	173
B	Ingersoll Rand	DML	FC	Yes	Red Dot	Standard	Frigette	Standard	173
C	Ingersoll Rand	DML	IR	Yes	Red Dot	Standard	Frigette	Standard	173
D	Ingersoll Rand	DML	FC4500	Yes	AC/Heater	Standard	AC/heater	Course	237
E	Ingersoll Rand	DM45E	IR	Yes	AC/Heater	Standard	AC/heater	Course	134
F	Tamrock	D45KS	Tamrock*	Yes	Red Pack	Standard	AC/heater	Course	132
G	Ingersoll Rand	DM45E	FC3600	Yes	Red Dot	Standard	AC/heater	Course	159
H	Driltech	D50K	Driltech	Yes	Red DotAC	Standard	AC/heater	Course	111
I	Tamrock	D45KS	Tamrock	Yes	RDAC/Heater	Standard	AC/heater	Course	147
J	Reedrill	SK-45I	Reedrill	Yes	RDAC/Heater	Standard	AC/heater	Course	144
K	Driltech	D40K	Driltech	Yes	RDAC/Heater	Standard	Frigette	HEPA	118
L	Reeddrill	SK50i	FC3600	Yes	KW AC/Press.	Standard	Fan	Course	145
M	Reedrill	SK50i	FC3600	Yes	KW AC/Press.	Standard	Fan	Course	145
N	Ingersoll Rand	DM45E	FC3600	Yes	KW AC	Standard	Fan	Course	157
O	Bucyrus-Erie	61-R-3	Wet Drill	Yes	Heater	Standard	Heater	Course	457
P	Driltech	D40K	Driltech	Yes	Komatsu Heater	Standard	AC/heater	Standard	40

KW – Kysor Westran
FC – Filter Cyclone Dust Collector
IR – Ingersoll Rand Dust Collector
Mine B – RD Unit 78R5100 DCI 6261A4187-1 Donaldson Filter
Mine C – RD fan & Cannister DCI 6261A4187-1 Donaldson Filter
Mine D – Baldwin PA1681-FN filter in cannister on top of cab filters air
Mine F – Tamrock Driltech Drill

Table 2. Gravimetric and quartz measurements for each highwall drill surveyed.

Mine	Resp. Outside mg/m³	Resp. Inside mg/m³	Total Outside mg/m³	Total Inside mg/m³	Quartz Outside Percent	Quartz Inside Percent	Quartz Outside ug/m3	Quartz Inside ug/m3	Reduct Resp. Conc. %	Reduct. Total Conc .%	Reduct. Quartz Percent	Reduct. Quartz Conc. %
A	0.32	0.29	1.13	0.46	23	19	74	55	9	59	17	25
B	2.67	0.27	10.00	0.35	55	4	1469	11	89	96	92	99
B	0.37	0.10	1.44	0.21	32	14	118	14	72	85	56	88
C	1.90	0.07	8.99	0.20	14	18	266	13	96	97	--	95
D	2.17	0.29	9.96	0.70	27	15	586	44	86	92	44	93
E	0.99	0.13	4.01	0.36	38	24	376	31	86	91	36	92
F	2.96	0.04	12.70	0.05	25	11	740	4	98	99	56	99
G	0.04	0.03	0.17	0.12	6	6	2	2	25	29	0	25
H	0.24	0.17	1.97	0.41	26	8	62	14	29	79	69	78
I	0.37	0.07	3.18	0.20	10	8	37	6	81	94	20	85
J	2.57	0.98	13.42	4.92	16	12	411	118	62	63	25	71
K	0.08	0.09	0.45	0.19	26	15	21	14	--	57	42	35
L	2.65	0.90	7.90	1.16	71	41	1882	369	66	85	42	80
M	0.34	0.09	3.93	0.28	15	14	51	13	73	92	6	75
N	0.24	0.43	1.36	0.66	9	1	22	4	0	51	88	80
O	3.77	0.56	20.65	2.12	30	33	1131	185	85	90	83	84
P	0.47	0.25	1.92	0.67	17	9	80	23	47	65	47	72

Table 3. Highwall drill measured differential cab pressures.

Mine	Pressure Low in. wg.	Pressure Medium in. wg.	Pressure High In. wg.
A	0.04	0.09	0.16
B	>1.0	>1.0	>1.0
B	0.97	0.98	0.95
C	0.26	n/a	0.24
D	Neg.	Neg.	Neg.
E	0.08	0.08	0.08
F	0.71	0.78	0.86
G	0.33	0.38	0.42
H	0.02	0.03	0.03
I	0.00	0.00	0.00
J	0.01	0.01	0.02
K	0.00	0.02	0.00
L	0.02	0.04	0.06
M	0.12	0.24	0.35
N	0.10	0.10	0.20
O	0.02	n/a	n/a
P	<0.01	<0.01	<0.01

Neg. - Negative Differential Pressure
n/a - Fan Speed Not Available on System