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by

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ABSTRACT

Dust production measurements were made in an ore and waste dump area. The dust production from dumping ore was about 0.7 mg total respirable dust per tonne and 0.2 mg respirable quartz per tonne. The dusty air from dumping ore and waste, as well as the ore pass emissions were drawn through wet type dust collectors. The actual dust emissions into this circulating air stream were about 100 mg total respirable dust per tonne and 60 mg respirable quartz dust per tonne.

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INTRODUCTION

The dust productions at a number of mining operations have been described previously (1). It was shown that ore handling is a major potential source of dust. During some tests on a wet dust collector installed underground at an ore dump (2), the opportunity was taken to determine dust production from the ore dumping operations and the total emissions into the ventilating airstream when the dust collectors were in normal operation. That is, the ore dump collector (size 35, 16.5 m^3 air/sec) was running for most of the shift, and the waste dump dust collector (size 9, 4 m^3 air/sec) was run just during the dumping operation.

EXPERIMENTAL TECHNIQUES

The techniques used were similar to those in the previous studies (1) with dust measurements being made in the air entering and leaving the operation. However, new experimental size selective dust samplers with a higher air flow rate, 4 L/min, were used. The size selector section is weighable and the coarse dust fraction as well as the respirable fraction can be determined (3). The respirable dust collected on the filter is assessed by weighing and by X-ray diffraction for the quartz fraction (4). The recent ventilation measurements made by the mine, and the rated airflow rate of the wet dust collector were used in calculation of dust production. The tonnage of ore dumped was determined by counting mine cars and their rated capacity.

TEST SITE

The test site is shown in Figure 1. Almost clean intake air enters from the shaft station, off the sketch at the lower left, comes to a split with 70% of the travelling to the left, and the 30% of interest travelling to

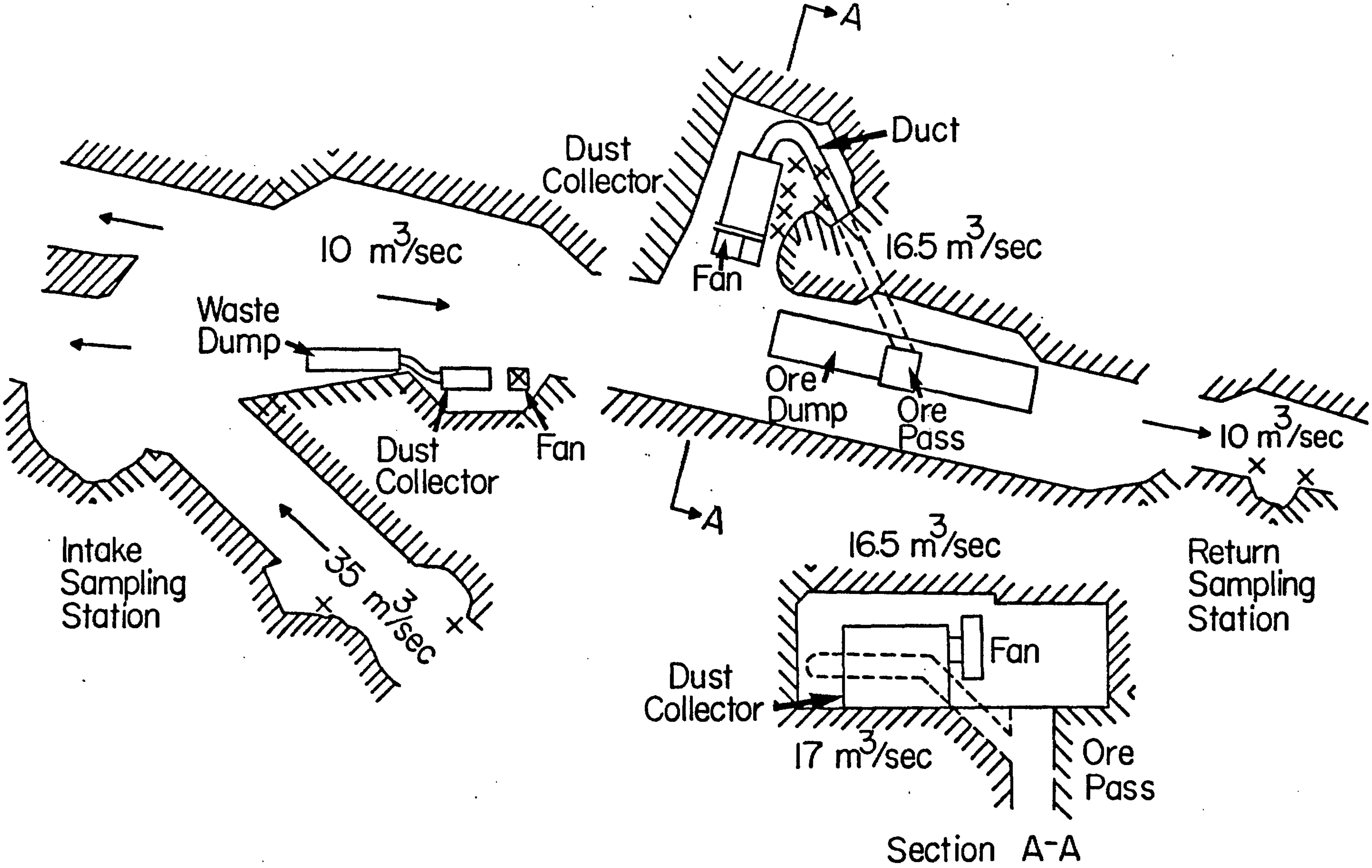

Fig. 1 - Test site.

the right. This air passes the waste and ore dumps before exiting to the right.

The waste dump handles side emptying cars and is covered by a door when not in use. A Precipitaire, model 9, 4.4 m^3/sec, wet dust collector draws air from the dump pocket and cleans it before returning it to the main ventilation stream. The dust collector is only operated during the dumping period.

The ore pass handles bottom emptying cars. There is no provision for a cover. A Precipitaire, model 36, 16.5 m^3/sec, wet dust collector draws air from the dump pocket and returns it to the main airstream prior to the dump point.

Substantial recirculation occurs through the ore pass and dust collector.

This entire site has a number of dust sources:

1. Waste dumping - partially controlled by wet dust collector;
2. Waste pass - controlled by door;
3. Ore dumping - partially controlled by wet dust collector;
4. Ore pass - partially controlled by wet dust collector;
5. General emissions generated by traffic.

Of these the specific operations, ore dumping and ore pass were studied together with the total emissions from the area into the main ventilation stream.

The ore dump dust production was studied by running samplers in the dust collector intake during the 15 to 60 sec dump point and for 3 to 5 min afterwards. The 'ore pass' dust was obtained by the difference between samplers run continuously and the dump samples described above. However, further analysis of the continuous monitor results taken at the test site showed that the dust concentration takes about 15 min after the dump to decay to the pre-dump levels, and these are not really ore pass as distinct from ore dump measurements.

RESULTS

The dust measurements made in the inlet and outlet air of ore dump dust collector were given in another report (2), and are given as means in Table 1. Table 1 also shows all the dust measurements in the intake and return sampling stations.

From the measurements some dust productions can be determined:

Dust production = wt. of sample x ventilation air flow/sampler air flow.

This is divided usually by units of operation, say tons, to give dust production per unit of operation. The results are presented in Table 2.

The dust productions from dumping and the ore pass are substantial enough to load some 15 m^3/sec of air to the TLV of 0.1 mg/m^3 for respirable quartz. Expressed differently this is the amount of dilution air required. With the wet dust collectors installed only about 0.5 m^3 air/sec is required, and the 10 m/sec is usable for diluting other dust sources.

In designing these experiments it was assumed that the 16.5 m^3/sec of airflow through the dust collector would change the air in the ore pass about once per minute, and that the few minutes after the dump would collect all the airborne dust produced by dumping. However, because it takes about 15 min for the dust levels in the dust collector intake to decay to the before dump level, it is evident that there must be some nearly stagnant air pockets in the ore pass from which the dusty air is only slowly entrained into the high volume flow through the dust collector. This suggests the wet dust collectors should include a delay in their off switch to ensure treatment of these pockets of stagnant air. It was noticed that the waste dump dust collector was turned off immediately after dumping.

Table 1 - Dust measurements

Sampling Station	Day 1 mg	Day 1 mg/m³	Day 2 mg	Day 2 mg/m³	Day 3 mg	Day 3 mg/m³
Intake						
Sampling period, min	357		350		300	
Sampler 1 - TRD[1]	0.05	0.035	0.10	0.07	0.12	0.10
- RQD[2]	0.001	0.0008	0.0015	0.005	0.002	0.002
Sampler 2 - TRD	0.02	0.014	0.0008	0.005	0.002	0.002
- RQD	0.006	0.004	0.003	0.002	0.009	0.008
Return						
Sampler 3 - TRD	0.08	0.06	0.19	0.14	0.10	0.08
- RQD	0.0075	0.005	0.0215	0.015	0.014	0.012
Sampler 4 - TRD	0.04	0.03	0.19	0.14	0.06	0.05
- RQD	0.007	0.005	0.0275	0.019	0.02025	0.020
Dust Collector Intake						
Sampling period, min	308		251		269	
Mean - TRD	0.49	0.40	0.77	0.79	0.69	0.65
Mean - RQD	0.255	0.20	0.412	0.41	0.362	0.335
During Dumping Only						
Sampling period, min	55		39		27	
TRD	0.12	0.55	0.24	1.54	0.14	1.3
RQD	0.095	0.42	0.114	0.73	0.075	0.7
Dust Collector Outlet						
Sampling period, min	308		251		269	
Mean - TRD	0.08	0.07	0.13	0.13	0.11	0.11
Mean - RQD	0.012	0.010	0.019	0.019	0.016	0.015
During Dumping Only						
Sampling period, min	55		39		27	
TRD	0.05	0.23	0.11	0.71	0.03	0.28
RQD	0.0055	0.025	0.003	0.019	0.003	0.028

[1] TRD - total respirable dust
[2] RQD - respirable quartz dust.

Table 2 - Dust production

	Day 1	Day 2	Day 3	Mean
Ore Dumping (short period)				
Tonnes dumped	715	950	730	800
mg TRD/tonne[1]	24	35	23	27
mg RQD/tonne[2]	20	18	15	18
Ore Dumping (total)				
Tonnes	715	950	730	800
mg TRD tonne	98	112	113	108
mg RQD tonne	54	65	72	64
Total Emissions from Area				
Tonnes dumped	760	1060	1260	1030
mg TRD/tonne	5	17	0	7
mg RQD/tonne	0.7	4	2	2

[1]TRD - total respirable dust
[2]RQS - respirable quartz dust.

DISCUSSION

The results obtained show that ore dumps can produce substantial amounts of dust, and that the Precipitaire wet dust collectors are successful in collecting a high proportion of it and very substantially reduce the amount of air required to dilute the dust to an acceptable level.

It shows also that there were large nearly stagnant zones of dusty air in the ore passes from which the dust only escaped slowly . This indicates the desirability of continuing the operation of the dust collectors for some 15 min after each dump. For the last dump of the shift, it seems desirable that a delay off switch should be used.

ACKNOWLEDGEMENTS

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