DUST CONTROL AT VERTICAL ORE AND WASTE PASSES**

By P.F. Pullen*

In any mine the ore and waste pass system is a potential source of dust which may contaminate the air supply to working areas. Inclined pass systems with control chains may or may not present a major and continuing dust source depending on the details of the system. At the Quirke mine, vertical passes were driven which resulted in major surges of high-pressure dusty air on levels below the point of dumping.

The New Quirke mine of Rio Algom Mines Ltd. is situated on the north limb of the quartzite formation containing the uranium-bearing deposit of the Elliot Lake area. The current milling rate is 4 700 tons per day.

New Quirke was developed by a rectangular timbered shaft sunk to 690m with levels numbered 2 to 11, the latter being the spill pocket. During the completion of shaft sinking through the skip compartment, level development was carried out by skipping development muck in cars in the large cage.

A reduction of 67m in length and a saving of three weeks in driving time was gained by driving vertical as opposed to inclined passes. Passes were driven from the 5th and 8th Levels by Alimak machine. The ore pass is 3,1m x 3,1m and the waste pass 2,4m x 2,4m. Control chains were installed in the ore pass at 5 level only, representing the only discontinuity of the straight fall in the system.

As soon as the pass system became active, the magnitude of the dust problem caused by vertical passes became apparent on the lower levels. The covers on all the dumps were not completely sealed and the piston action of broken muck falling from 1 to 3 levels (47m level interval) without a break forced large volumes of air ahead of it which could only be relieved through the lower level dumps.

The force of the air was so great that the heavy steel articulated doors and two operating air cylinders would be forced open several feet. As a result the back of the drift over each dump point became plastered with mud ejected from the pass. Fig. 1 is an outline drawing of the dump with air actuated hinged steel door.

The general arrangement of the pass system at each level is shown in Fig. 2. During the driving of the raises, and their initial operation, the interconnection at each level had become partly blocked with muck and dust, rendering them mainly ineffectual. When these interconnections were cleaned out, the major surges of dusty air were relieved to a considerable extent.

In order to prevent the ventilation by-pass from again becoming plugged with muck, it was necessary to slash the foot-wall of the by-pass and to install heavy bulkheads.

The pass system at this stage, (Fig. 3) before the addition of the pass system exhaust raise from 8 level which was added later, made it possible to relieve pressure ahead of the falling muck. The dusty air escaped through the ventilation by-pass at each level from one pass to the other, and re-entered the original pass on the level above to fill the void created behind the falling muck. The success of this system depends on the ability to keep the muck height in the waste pass system below the lowest mining level.

At this stage, an exhaust from the pass system became essential in order to maintain the system under negative pressure and so reduce the escape of dust. Because the pass system was vertical, it was close to the shaft throughout, and on the top level, was some 600m from the exhaust airway system.

Two 965 mm axial flow fans were installed in the access cross-cut on 2 level to exhaust 34 m^3/s at 750 Pa static pressure from the system. This dusty air was discharged along the main cross-cut to the return air system. Personnel were not using this cross-cut at the time.

When no muck was being dumped this exhaust system resulted in a strong in-draft at the dumps on the upper levels, decreasing at lower levels. When a dump door was opened, and a train dumped,

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practically all the air for the system entered the open pass door and the suction of the fans was reduced in the pass system below this point. In fact, because of the pressure build up ahead of the falling muck, the lower dumps still had a strong out-cast of dusty air.

The system at this time was largely ineffectual in containing dust within the pass system on the lower levels and the point of exhaust was changed to the 8 level, the bottom of the system so that the exhaust would be from the high-pressure end of the system when muck was dumped.

This change was accomplished by driving a special pass exhaust raise from 8 level to above 7 level (Fig. 3) and then driving an inclined raise in ore to connect to a completed stope in the return air system at 6 level. Two 1200 mm axial flow fans were installed in parallel to exhaust a total of 40 m^3/s at 375 Pa static pressure. The exhaust fans on 2 level were then removed.

This change brought about a considerable decrease in the quantity of dust escaping from the system. However, it was still essential that the height of muck in the waste pass be kept below 8 level to achieve maximum efficiency.

When muck in the waste pass system is above 7 level the by-pass at 8 level becomes less effective when dumping into the ore pass.

With the present system in operation, static pressures to just over 500 Pa are measured at 8 level in the ore pass. When the ventilation by-pass becomes blocked the pressures become several times greater, and are still sufficient to raise the heavy steel pass doors.

As originally installed, concrete for the ore or waste pass door protruded several inches beyond the lip of the granby-type cars in the dump position. This resulted in an erosion of the concrete as the last muck dribbled out of the car, causing a serious gap between the concrete and the dump door in the closed position. This was corrected by installing a heavy steel wear plate on each dump and a rubber sealing strip on the edge of the door.

Because of the build-up of air pressure in the ore pass system while muck is being dumped, large volumes of dusty air were forced into the crusher chamber when the crusher operator pulled the pass system nearly empty. To overcome this a gamma gauge and gieger-tube detector are installed on opposite sides of the ore pass some 8m above the crusher.

When muck is pulled below the level of the detector a red light and horn are activated at the operator's station and the crusher is shut down, preventing an out-flow of dust from the pass. This system has had its problems because the detector is damaged as the ore pass wears larger. Other systems are being investigated to signal a nearly-empty pass.

Dust control in the crusher station is effected by exhausting 4,25 m^3/s from the pitman tunnel below the crusher, with air being drawn down through the under-size grizzly and the crusher jaws.

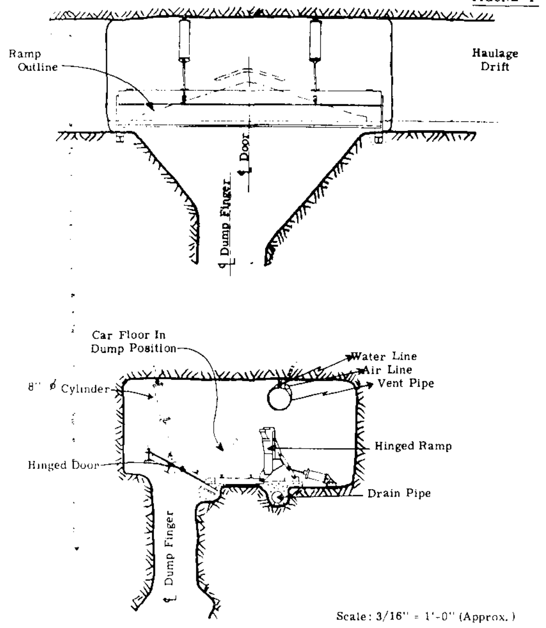
The location of the dusty air take-off near the end of the pitman tunnel provides a settling chamber for coarse dust and relieves the dust filter of considerable load. The dust discharged from the filter passes directly into the ore pass raise below the crusher.

Cleaned air discharged from the filter is discharged into a 760mm pipe and conveyed up the shaft and discharged into the ore and waste pass system on 7 level.

The ventilation and escape raise shown in Fig. 3 provides a source for replacement air exhausted from the crusher station. A fan at the top of the raise forces 8,5 m^3/s down the raise and this volume is split between the crusher station and the loading pocket. The source of this air is the bottom of the west fresh airway which has now been completed to the 8 level and so good quality air is provided to both the crusher and loading pocket.

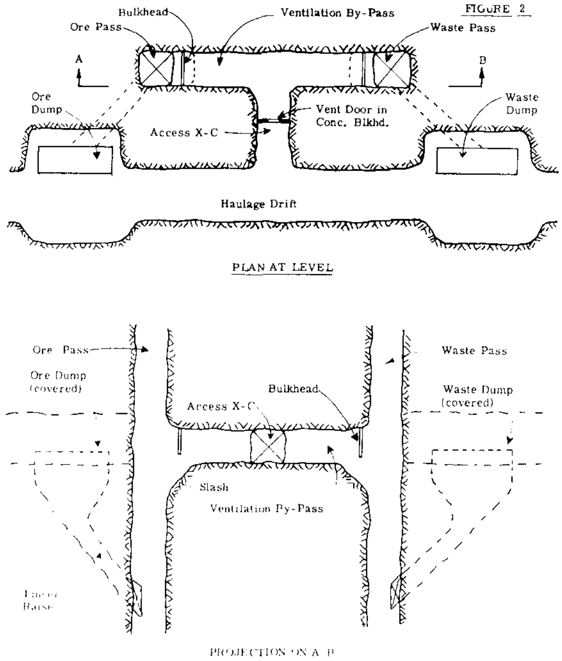
Before the pass sytem exhaust was developed to its present stage, contaminated air was reaching the crusher and loading pocket. At the latter site, a 0,3 m^3/s dust filter was installed to supply this volume of warmed air directly to the skip tender who operates from an enclosed booth. By pressurizing this booth

FIGURE 1



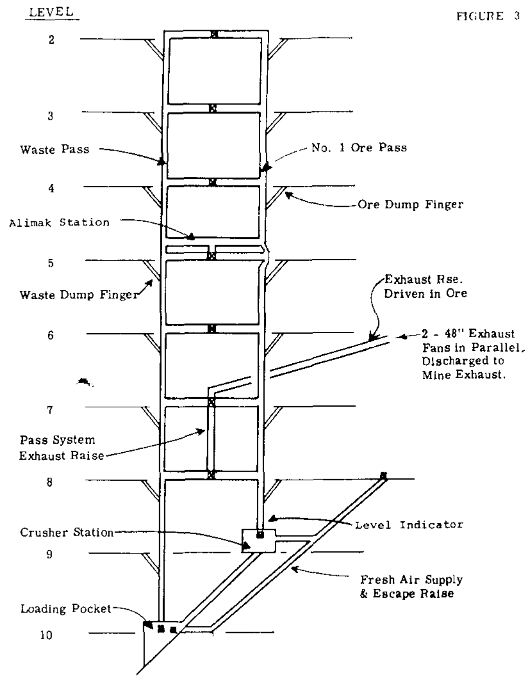
ORE & WASTE PASS DUMP DOORS - RIO ALGOM MINES LTD. 321/73

FIGURE 2



DUST CONTROL AT VERTICAL PASSES - RIO ALGOM MINES LTD 320/73

FIGURE 3



GENERAL ARRANGEMENT
VERTICAL PASS DUST CONTROL SYSTEM
RIO ALGOM MINES LTD. 333/73

with heated and filtered air, it is possible to encompass the operator in a comfortable, healthy environment.

By providing a booth that may be dismantled if repairs are required he was protected rather than attempting to enclose a very difficult dust source. The spread of dust from the loading pocket area is controlled by exhausting about 4,25m^3/s up the shaft in a plastic duct from below the lip of the pocket and discharging into the pass system on 7 level.

Advantages of vertical pass

- Shorter driving time because of shorter distance.
- Lower costs than sloped raise by Alimak because of shorter drive i.e. at Quirke 47m vs 57,5m @ + 55°.
- Lower costs than conventional timbered raise driven at more than + 50°.
- Easier slashing of vertical raise for storage. Mines Dept. allows slashing from bottom up with access from the top.
- Can be kept closer to shaft than sloped Alimak raise (no knuckle back in sloped Alimak). Eliminates possible hang up problems at knuckle back that is often necessary in inclined raises.
- Less abrasion and wear to ore pass.

Disadvantages of vertical pass

- Faster acceleration of dumped muck leading to more entrained air and therefore more outcast surge at dumps and other openings.
- Vertical Alimak driven sections are connected at levels by cones and transfer raises. Vertically falling muck does not break up as in incline passes and hangups occur periodically.
- Heavier outcast surge air from vertical raises require larger surge relief openings between ore and waste passes at levels.
- Larger fans required in surge relief raise from ore-pass.
- Heavier access and dump doors required to contain heavier surge pressure on openings.
- Possibly more difficulty in controlling impact damage to control chains when used at intermediate levels.
- On upper levels passes do not get closer to ore zone as with inclined raises and do not give shorter haulage distances.

ERRATA

WHAT IS THE NATURAL VENTILATION PRESSURE?

by C.J. Hall

Contribution by R. Hemp

Mr. Hemp's contribution was published in the October Journal, pages 170 - 174.

This excellent contribution was marred by errors whose presence has detracted from the sense of the contribution.

Listed below are corrections which readers are requested to make to Mr. Hemp's contribution.

1. All symbols ϕ should be replaced by $\oint$.
2. Add: ''(see page 173)'' at the end of the fourth paragraph on page 171.
3. The topmost table on page 173 should be right adjusted to line up with the columns because this table is the heading for the tables below.

The editors would like to take this opportunity of expressing sincere apologies to Mr. Hemp and to readers for the presence of these unfortunate errors and for any inconvenience caused.