VENTILATING PRACTICES THAT MINIMIZE EXPLOSION HAZARDS IN BITUMINOUS-COAL MINES

BY M. J. ANKENY, JAMES WESTFIELD, AND D. S. KINGERY

United States Department of the Interior — September 1952
VENTILATING PRACTICES THAT MINIMIZE EXPLOSION HAZARDS IN BITUMINOUS-COAL MINES

BY M. J. ANKENY, JAMES WESTFIELD, AND D. S. KINGERY

* * * * * * * * * Information Circular 7648

UNITED STATES DEPARTMENT OF THE INTERIOR
Oscar L. Chapman, Secretary
BUREAU OF MINES
J. J. Forbes, Director

Work on manuscript completed July 1952. The Bureau of Mines will welcome reprinting of this paper, provided the following footnote acknowledgment is made: "Reprinted from Bureau of Mines Information Circular 7648."
VENTILATING PRACTICES THAT MINIMIZE EXPLOSION HAZARDS
IN BITUMINOUS-COAL MINES

by

M. J. Ankeny,1/ James Westfield,2/ and D. S. Kingery3/

CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Summary</td>
<td>1</td>
</tr>
<tr>
<td>Scope and purpose of study</td>
<td>1</td>
</tr>
<tr>
<td>Recommendations</td>
<td>2</td>
</tr>
<tr>
<td>Discussion of operating plans</td>
<td>3</td>
</tr>
<tr>
<td>Plan A</td>
<td>3</td>
</tr>
<tr>
<td>Plan B</td>
<td>3</td>
</tr>
<tr>
<td>Plan C</td>
<td>4</td>
</tr>
<tr>
<td>Plan D</td>
<td>5</td>
</tr>
<tr>
<td>Plan E</td>
<td>5</td>
</tr>
<tr>
<td>Plan F</td>
<td>5</td>
</tr>
<tr>
<td>Plan G</td>
<td>6</td>
</tr>
<tr>
<td>Plan H</td>
<td>6</td>
</tr>
</tbody>
</table>

ILLUSTRATIONS

<table>
<thead>
<tr>
<th>Fig.</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Ventilating plan A</td>
<td>6</td>
</tr>
<tr>
<td>2</td>
<td>Ventilating plan B</td>
<td>6</td>
</tr>
<tr>
<td>3</td>
<td>Ventilating plan C</td>
<td>6</td>
</tr>
<tr>
<td>4</td>
<td>Ventilating plan D</td>
<td>6</td>
</tr>
<tr>
<td>5</td>
<td>Ventilating plan E</td>
<td>6</td>
</tr>
<tr>
<td>6</td>
<td>Ventilating plan F</td>
<td>6</td>
</tr>
<tr>
<td>7</td>
<td>Ventilating plan G</td>
<td>6</td>
</tr>
<tr>
<td>8</td>
<td>Ventilating plan H</td>
<td>6</td>
</tr>
</tbody>
</table>

SUMMARY

All bituminous-coal mines, by the nature of their product and inherent gassy tendencies, are subject to explosions or mine fires. The evolution from large, hand-loading sections employing numerous men and containing open-type equipment, lights, and nonpermissible explosives to small, concentrated mechanical sections with but few well-supervised men utilizing modern preventive equipment has not altered this premise.

Mine catastrophes such as Centralia and New Orient No. 2, as well as recent disasters of less magnitude, have refuted the trend of thinking that modern equipment, will prevent or localize explosions and prevent widespread damage or loss of life.

Considering the possibilities of explosion hazards, mechanical operations present many definite problems that, if not understood and corrected, may lead to further disasters. Rapid advance during development in virgin coal increases problems of methane and coal-dust control. The common mining practice of working a series of small adjacent producing panels, and driving rooms off both sides of room entries presents hazards of worked-out areas nearby active workings. Ventilation is complicated by these factors and is influenced by the movement of face and haulage equipment operating through ventilation aids, such as check curtains, doors, and line brattice. The continuous operation of electrical equipment within a concentrated face area, unless special preventive measures are taken, provides many ignition sources.

Modern ventilation has been defined as "the first-line defense against explosions." This necessitates a departure from previous concepts, which prescribed the quantity of air on the sole basis of men and animals employed, and gave little thought to ventilating worked-out areas, the number of sections safety permitted on a split, the difference between intake or return air, and isolating ignition sources.

SCOPE AND PURPOSE OF STUDY

This circular is intended to present important recommended practices that are necessary to minimize the possibilities of methane accumulations in coal mines and reduce the chances of ignitions from electrical sources.

The recommendations submitted in this report are based upon years of study and investigation of the causes of numerous coal-mine explosions by the Bureau of Mines. The ventilation and electrical plans presented illustrate mining
methods and ventilation practices in vogue throughout the bituminous coal-mining industry. Endeavor was made to select representative operations that comply with recommended practices and also are flexible enough to be adapted to most modern mining systems.

It is hoped that this information will prove valuable to officials, safety engineers, mine engineers, and mine employees by emphasizing the importance of good ventilation to mine safety and by illustrating practices applicable to modern mining:

RECOMMENDATIONS

The following recommendations are considered important to minimize the possibility of methane accumulations and ignition from electrical sources. These recommendations are not intended to replace Article V, Ventilation And Mine Gases, of the Federal Mine Safety Code but to emphasize and supplement the provisions in the code.

1. A split system of ventilation should be provided for operation of not more than two, preferably not more than one, mechanized unit on each split of air.

2. The air in each split should be circulated to each active working place and all dead ends on the split; after which, it may be used to ventilate abandoned, worked-out areas or the edges thereof before passing into the main return.

3. A system of bleeder openings and air courses providing for the continuous movement of air through abandoned or caved areas should be established to prevent accumulation of standing bodies of methane in these areas and to minimize the effect of variations in atmospheric pressure.

4. Worked-out, abandoned areas should be either ventilated or sealed. If abandoned areas are sealed, the seals should not be adjacent to intake airways, but openings in which seals are placed should communicate directly with the return airway.

5. The ventilation system should be designed so that air will circulate to the working faces without interruption. Use of doors on entries should be reduced so far as possible, but, where doors are used, they should be erected in pairs to form air locks.

6. No electrical equipment other than permissible equipment should be taken into or operated in other than pure intake air; equipment should be maintained in a good state of repair and in permissible condition.

7. Installation of trolley wire and all other power wires and cables, except trailing cables and insulated cables leading to permissible junction boxes, should be confined to pure intake air.

8. All power connections for face electrical equipment should be made in pure intake air unless such connections are made through permissible junction boxes.
9. Air entering each split should be pure intake air.

Pure intake air, is defined as air that has not passed through any active working places in face regions and has not passed through any worked out or abandoned areas or through or by the unsealed entrances to any abandoned or worked out areas.

DISCUSSION OF OPERATING PLANS

Several of the following plans have been changed slightly from actual operations to illustrate a specific point or to add flexibility. They are, however, actual operating plans graciously submitted by mining companies to be used in this paper. (See drawings of these plans at the end of this report.)

Plan A

This is the ventilation plan for two mechanical sections of a gassy mine operated in the Pittsburgh coal bed. A block system of mining is employed, pillars are recovered, and face equipment is off track, employing shuttle cars for haulage.

Each mechanized group of butt entries is on a separate split of air. Approximately 20,000 cubic feet of intake air per minute is coursed up the right side of each section. The ventilation current is controlled along the pillar line by a series of temporary stoppings or check curtains extending from the roof to the floor. Part of the air passes through the pillar area and is regulated to the bleeder entry at the top of the panel, which is connected to the return-airway system. The balance returns down the left side of the panel to the main return.

The battery-charging stations are on a separate split of air leading directly into the return air course. Permissible, battery-type shuttle cars travel the return air course to and from the charging stations.

Electrical adjuncts, such as the trolley wire, automatic circuit breakers, and safety cut-out switches are installed in intake air near the loading point. From these electrical terminals, insulated cables carry power to the section hook-up station, which is usually located within 250 feet of the pillar line. This station is ventilated by intake air leaking through check curtains. At this station, permissible face equipment is connected through trailing cables.

Line brattice or short wing curtains to direct the air to the working face are used as needed.

Plan B

This plan includes two producing panels of a gassy mine operating in the combined upper and lower Freeport coal bed. The mining system employs off-track face equipment in rooms 25 to 30 feet wide, driven from opposite sides of panel room entries; pillars are not recovered.

Bleeder rooms connecting panels are developed by joining the first two rooms of each producing panel. These bleeders connect to the return airway
system and serve as bleeder entries throughout the life of the panel. Succeeding rooms are driven in sets to the air barrier that is maintained between panels.

Intake air is delivered by separate splits to each panel and is coursed up both sides.

The producing side, which alternates with each set of rooms, is regulated at the intake to assure adequate sectional ventilation. The other side is also regulated at the intake to assure a sweep of standing entries and rooms. Air is controlled along the working faces by a series of temporary stoppings or check curtains reaching from roof to floor. After passing the active area, it passes through old workings where it is controlled by regulators to bleeder rooms and the return-airway system.

Trolley-wire and open-type electrical installations are installed in entries ventilated by controlled leakage of intake air that passes through the doors on the haulage road. This air joins the air ventilating the panel inby the loading point.

Face equipment is permissible type and receives power through permissible junction boxes placed along the rib outby the first crosscut of working rooms. The junction boxes receive power through insulated cables connected to automatic circuit breakers installed on intake air. Cut-out protection for section equipment, except the drill, is provided by unit cut-out switches located near the loading point.

When a panel is worked out, the regulator leading to the return is opened, and all other entrances to the panel are sealed with masonry stoppings.

Plan C

This plan is used for track mining in a gassy mine operated in the Pittsburgh coal bed. Coal is produced from development and pillar recovery of a block mining system.

A split system of ventilation provides intake air for each producing set of butt entries. Air is coursed along the right entry of each mechanical section to the face regions where it is controlled by a series of doors. The ventilating current of the right section splits at the right corner of the pillar line with a small portion passing directly into a return airway. The major part sweeps the pillar line, losing a certain amount of air through the pillar. Air from the right section is joined by intake air from the left section at the pillar-line junction between sections. Air passing through the pillared area ultimately reaches a set of bleeder entries interconnected with the return-airway system.

The haulage roads, which contain trolley wire for haulage and electrical connections to section equipment, are ventilated by approximately 3,000 cubic feet of controlled, intake-air leakage through doors.

Trolley-wire and all open electrical connections end outby the ventilation control doors, assuring that trailing cable connections will be made in intake air. Face electrical equipment is permissible type.
Line brattice or short wing curtains to direct air to the working faces are used as needed.

Plan D

This is a mining and ventilation plan for off-track development purposes. The mine is operated in the Upper Freeport coal bed and is classed gassy.

A split system of ventilation is used. Intake air passes through the middle entries of the main headings to the face area; it then splits right and left returning to ventilate butt entry development.

Controlled, intake-air leakage through doors from the main heading intakes ventilate the butt entry haulage roads. Consequently, trolley-wire, electrical hook-ups for butt entry face equipment and operation of haulage equipment are conducted on intake air.

Air returning from the mainheadings is controlled at the working faces by masonry stoppings, doors, and check curtains.

Electrical installations on main-heading development entries are maintained outby the last permanent stopping in intake air. All section equipment is permissible type.

Plan E

This plan includes both pillar development and pillar recovery in a gassy mine operated in the Pittsburgh coal bed. Mining is off-track, utilizing shuttle-car haulage. Development panels are advanced by nine headings in a conventional block system; pillars are recovered on retreat.

A separate split of air is provided for each panel. Approximately 30,000 cubic feet of intake air passes through the seven intake entries; it is checked at the working faces, if necessary, by line brattice. Air returns down the outside entries of the development panel to the return airway.

Along the pillar line, air is partly controlled by temporary stoppings or check curtains and splits three ways, passing to the right, left, and through the pillared area. The air passing through the pillared area and much of the air passing the left edge of the pillar line goes to a pair of old main headings now serving as bleeder entries. These are connected directly into the return-airway system. Air passing the right edge of the pillar line follows the outside heading to the return air course. All stoppings are solid masonry construction.

Mine-track, trolley-wire, and electric switches are installed in intake entries and terminate at the loading point, approximately 300 feet from the faces. Electrical connections for face equipment are made in intake air. Consequently, junction boxes are not used. All electrical face equipment is permissible type.

Plan F

This plan is for pillar recovery of a panel utilizing track mining. The mine is rated gassy and is operated in the Pittsburgh coal bed.

Each panel is on a separate split of air. Intake air enters the panel through overcasts and is coursed up the left side to the edge of the pillar,
then along the pillar line. Air is controlled by a series of doors, stoppings, and check curtains. A certain amount of air passes through the pillared area. This is directed toward the bleeder entry at the top of the panel by regulating the openings to the side bleeder entries.

The system of doors backed up by check curtains is arranged so that the possibility of short circuiting air is minimized. Enough air passes through check curtains and doors to ventilate the areas between them with intake air adequately.

The trolley-wire installation and all electrical connections for face equipment are made out by doors on intake air. Electrical face equipment is permissible type.

Plan G

This plan illustrates room and pillar mining and includes the method of ventilating worked out room panels. The mine is rated gassy and is operated in the lower Kittanning coal bed, which averages 40 inches thick.

A separate split of air is provided for each room panel; approximately 12,000 cubic feet per minute passes up the left entry to the room section. Approximately 4,000 cubic feet of air per minute passes up the haulage road as leakage through doors.

Air is controlled along the room faces by a series of check curtains and by line curtains as needed. After ventilating the working places, the air passes into bleeder entries maintained along the top of worked out panels. Some of the air passes through the pillared area to supplementary return airways maintained along the bottom of the panels. All bleeder entries connect to return airways. Air passing through the pillared area is partly controlled by regulators.

Trolley wire is installed on the haulage road. Covered cables carry power from the circuit-distribution box to the section hook-up junction boxes. All section equipment is permissible type. Permanent stoppings are masonry construction, and check curtains extend from the roof to floor.

Plan H

This plan is for recovering chain and barrier pillars employing a continuous mining machine. The mine is operated in the Upper Freeport coal bed, which averages 80 inches thick and is classed gassy.

Intake air is coursed up all of the old headings and directed to the working room by means of plastic temporary stoppings across entries to gob areas and return airways opposite the side being mined. After ventilating the single working place, air goes directly into the return. Leakage through plastic stoppings assures that the edges of the pillared area are ventilated. One parallel bleeder entry on each side of the barrier pillars continues to serve as a bleeder and is connected directly to return air courses. All entries are intakes; consequently, all operations are conducted on intake air.
Figure 1. - Ventilating plan A.
Figure 2. - Ventilating plan B.
Figure 3 - Ventilating plan C.
Figure 4. - Ventilating plan D.
Figure 5. - Ventilating plan E.
Figure 6. - Ventilating plan F.
Figure 7. - Ventilating plan G.