Ventilation Overview

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Introduction

- General ventilation practices
- Calculating face concentrations
- Previous use of belt air
- Current use of belt air
- Gateroad development
- Longwall extraction
- Summary
Number of U.S. Longwalls

- Approximately 49 coal longwalls
- 5 – Four entry (Blue Creek / Poc #3)
- 39 – Three entry
- 5 – Two entry (Utah)
### Air Velocity Guidelines

<table>
<thead>
<tr>
<th>Entry</th>
<th>Velocity (ft/min)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intake</td>
<td>600 - 1000</td>
</tr>
<tr>
<td>Return</td>
<td>600 - 1000</td>
</tr>
<tr>
<td>Track (intake)</td>
<td>400 - 600</td>
</tr>
<tr>
<td>Belt (intake)</td>
<td>100 - 250</td>
</tr>
<tr>
<td>Belt (neutral)</td>
<td>50 - 200</td>
</tr>
</tbody>
</table>

- Economical step functions
Use of Belt Air

- Provides a secondary source of intake air to the working face
Calculating Face Concentration

\[
C_F = \frac{(C_I \times Q_I) + (C_B \times Q_B)}{Q_I + Q_B}
\]

Where:
- \(C_I\) = Intake concentration
- \(Q_I\) = Intake air quantity
- \(C_B\) = Belt concentration
- \(Q_B\) = Belt air quantity
- \(C_F\) = Face concentration
Calculated vs. Actual Face Dust Concentrations (NIOSH)
Calculated vs. Actual Face Dust Concentration (MSHA)

- Intake Q (Meas)
- Belt Q (Meas)
- Intake C (Meas)
- Belt C (Meas)
- Face C (Calc)
- Face C (Meas)

75.350(b)(3)
75.350(b)(6)
Calculated Methane at Tailgate

Methane Emissions $\text{m}^3/\text{s}$

Methane Emissions cfm

Shearer
Calculated
Background
Belt
Face Conveyor

Time

17:00 18:00 19:00 20:00 21:00 22:00 23:00 0:00
Calculated vs. Measured Methane at Tailgate (NIOSH)
Effects of Contaminants on Face Concentrations

Dust
- Expect actual face respirable concentrations to be greater than calculated due to dust sources positioned between intake/belt sampling locations and face location.

Gases (CH₄, CO, CO₂)
- (CH₄) Unless gas intrusion from gob at headgate, actual face concentration should be close to calculated value.
- (CO, CO₂) Actual face value could exceed calculated if diesel-powered vehicles are in intake entry inby sampling locations.
Three Entry Ventilation

• Most common layout (39 longwalls)
• Belt
  – Intake
  – Neutral outby
• Intake
  – Track
  – Travelway
  – Primary escapeway
• Return
Intake Belt Air
Three-entry Development Panel

12,000 ft gateroad with 65 crosscuts
Neutral Belt Air
Three-entry Development Panel

12,000 ft gateroad with 65 crosscuts
Belt Neutral Outby
Increased Pressure Loss

- Intake airflow increased from 70 to 110 K cfm
- \( P = RQ^2 \sim (110/70)^2 = 2.47 \) times initial pressure loss down intake entry
- Increased pressure across the return stoppings
  \[ = (2.47 + 1)/2 = 1.73 \] times higher
- \( Q = (P/R)^{1/2} \)
- \( Q = 1.32 \times 35,000 = 46,000 \) cfm leakage
Final Airflow and Leakage
<table>
<thead>
<tr>
<th></th>
<th>Belt – Intake (cfm)</th>
<th>Belt – Neutral (cfm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Belt entry</td>
<td>20 K</td>
<td>10 K</td>
</tr>
<tr>
<td>Intake</td>
<td>70 K</td>
<td>130 K</td>
</tr>
<tr>
<td>Return</td>
<td>90 K</td>
<td>105 K</td>
</tr>
<tr>
<td>Last open crosscut</td>
<td>55 K</td>
<td>55 K</td>
</tr>
<tr>
<td>Leakage into return</td>
<td>35 K</td>
<td>50 K</td>
</tr>
<tr>
<td>Leakage into belt</td>
<td>0</td>
<td>15 K</td>
</tr>
</tbody>
</table>
Intake Air Velocities

• Assume entry has 15.5 foot width and 7 foot height; area = 108.5 ft²

• Belt on intake
  – Velocity in track intake ~ 650 ft/min

• Belt on return
  – Velocity in track intake ~ 1200 ft/min
Three Entry Longwall Extraction (Eastern Mine)

- Belt air methane liberation is a significant contributor to longwall face methane levels
- The use of intake belt air becomes a hindrance as the longwall panels increase in length
- 14,000 ft panel with 25 K cfm intake recorded 0.7% methane in belt entry at the beginning of the panel
14,000 ft Long Panel

Belt air to headgate 0.7% CH₄
14,000 ft Long Panel
## Panel Ventilation Results

<table>
<thead>
<tr>
<th></th>
<th>Belt – Intake (cfm)</th>
<th>Belt – Return (cfm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Belt entry</td>
<td>25 K</td>
<td>25 K</td>
</tr>
<tr>
<td>Intake</td>
<td>80 K</td>
<td>80 K</td>
</tr>
<tr>
<td>Return/Intake</td>
<td>30 K</td>
<td>50 K</td>
</tr>
<tr>
<td>Shield #10</td>
<td>55 K</td>
<td>80 K</td>
</tr>
<tr>
<td>Shield #139</td>
<td>45 K</td>
<td>60 K</td>
</tr>
<tr>
<td>Headgate T</td>
<td>75 K</td>
<td>105 K</td>
</tr>
</tbody>
</table>
Advantages

- Belt on neutral outby
- The second isolated intake can supply more air to the headgate T junction
- Headgate at a higher relative pressure
- Increased airflow across longwall face
- Increased airflow to bleeders (sweetener)
Summary (Eastern Mines)

- Three entry gateroads have a difficult time during development with belt as neutral outby without pre-methane drainage.
- Three entry gateroads during panel extraction have over the past few years gone to dual intakes, with belt neutral outby.
Western and Illinois

- Western mines – two entry Utah, require belt air on longwall extraction
- Spontaneous combustion
- Illinois – lower methane coal (Springfield, Herrin); belt air on intake does not bring excessive methane to working areas
Questions