a hybrid pit evaluation shows that the results differ. The inherent consideration of joint block probabilities in the presented method generated a more robust result. ■

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A field study of longwall mine ventilation using tracer gas in a trona mine

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To read the full text of this paper (free for SME members), see the beginning of this section for step-by-step instructions.

Special Extended Abstract

A ventilation research study was conducted by the U.S. National Institute for Occupational Safety and Health (NIOSH) and a cooperating longwall trona mine in the Green River basin of Wyoming in the United States. The objective of the study was to evaluate the movement of longwall face air and exchanges between the face and worked-out areas to document the presence or absence of face airflow pathways between these locations. Tracer gas experiments using sulfur hexafluoride (SF_6) were conducted to describe air movement on the face and in the mined portion of the active panel. Maintaining adequate ventilation air on longwall faces is important for worker safety and for the dilution of gases emitted from the face and caved gob.

Methodology

Tracer gas was released at the study site in two separate monitoring experiments. One test was focused on airflow on the 228-m (750-ft) longwall face of the active panel, and the second on gas transport in the mined-out portion of the same panel. This approach allowed for the volumes of the tracer gas releases and the duration of monitoring to be optimized for each test. The SF_6 was released in a rapid, short-term fashion (slug), and its migration through the mine was tracked by sampling at stations.

Face test

The sampling locations and tracer gas arrivals are shown in Fig. 1. Following the rapid gas release in the legs of shield 1, the tracer was first measured at mid-face line 3 followed by lines 4 and 5. This behavior of tracer gas suggests that a portion of air from the release location traveled in a region behind the shield line and reached the mid-face region first. Subsequent arrivals at the sampling locations occurred at lines 6 and 7, gas moving in the gateroads inby and outby, respectively. At line 7, there were measurements of SF_6 above 1 ppb until 1.5 h after the release, which may indicate residence time within a portion of the gob. Such behavior demonstrates rapid movement of tracer gas to line 6

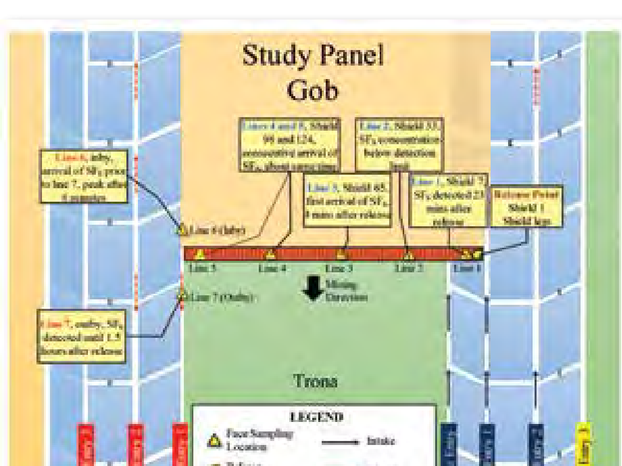

Fig. 1 Face test sampling locations and ventilation configuration.

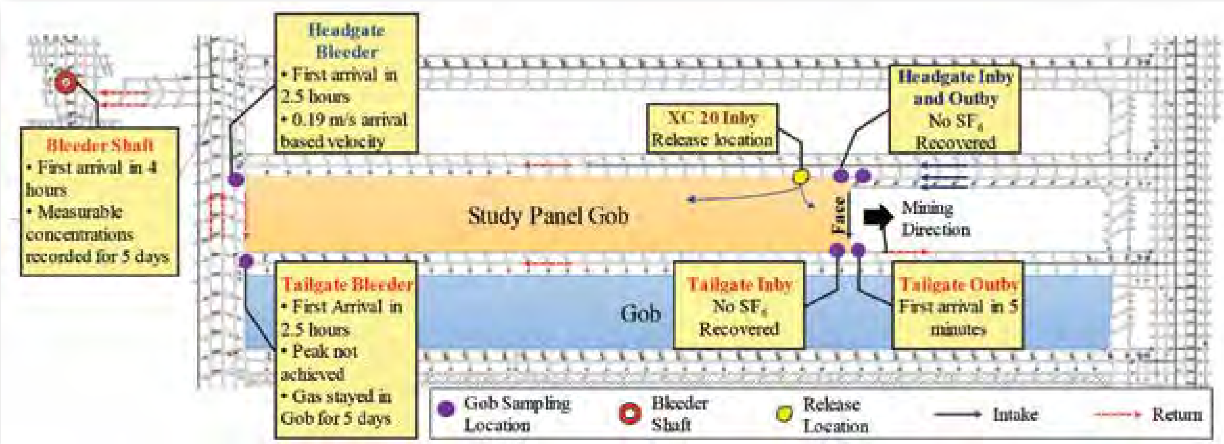

Fig. 2 Gob test sampling locations and results.

and a longer duration of tracer gas at line 7. The sampling location closest to the release point was line 1, but tracer gas was not measured here until 23 minutes after release. Such behavior is thought to be representative of tracer gas residing in the gob for a period before flowing back on the face. On line 2, a detectable amount of tracer gas was not seen throughout the duration of the sampling period. The lack of tracer gas at line 2 may be the result of the influx of fresh air in the zero entry. The behavior of tracer on the face can only be explained by the presence of air movement within the shield legs and rapid air transport at the front of the caved gob. Both pathways of air movement show transport in the head to tail direction.

Gob test

The sampling locations and tracer gas arrivals are shown in Fig. 2. The gob test was conducted for a duration of five days. The operator was mining on the evening eight-hour shift and NIOSH staff were monitoring during the daylight shift. Only one shift per day was monitored during the study. For this test, the tracer gas release was designed to be much greater than the face release to account for dilution in the gob. SF_6 was released two crosscuts inby the face on the headgate side, at crosscut 20. The gob tracer gas test indicated a rapid path of movement of gas from two breaks inby the face on the headgate side of the gob to the sampling location just outby the tailgate corner on the active face. Tracer gas arrived at the tailgate outby location five minutes after the release. A possible explanation for such behavior is that the gas moved outby from the release location toward the face and eventually mixed with face air flowing toward the tailgate. However, the focus of this test was on gob gas transport and potential face air interaction. Without gas sampling on the face during this test, the exact path of near-face movement is not known. Tracer gas was not detected at the tailgate inby; the large quantity of air at this location may have led to tracer gas concentrations being below detection limit. No tracer gas was detected at headgate inby and outby locations, as expected based on the release location. The tracer gas was detected at headgate and tailgate bleeder locations 2.5 hours after the release and at the bleeder shaft four hours after the release. The data suggest that the primary path of tracer gas movement from the release location was toward the back of the panel at a velocity of about 0.19 m/s (37 fpm). Transport of tracer gas through the gob was rapid to the headgate and tailgate bleeders and to the bleeder shaft near the back of the study panel. The maximum concentration of tracer gas at all three locations was reached on the first day of testing. Low concentrations of tracer gas were measured at all three of these locations throughout the remainder of monitoring.

Sufficient ventilation air on a longwall face is critical for the safety and health of crews working in the face area and to meet statutory requirements for gas concentrations. The presence of multiple pathways of face air movement and the range of pathways of gas transport and rates of movement demonstrated by this and related NIOSH field studies show a degree of interaction between the gas at the front of the active panel gob and the face air. Therefore, atmospheric monitoring in this area can greatly improve mine safety. ■

Disclaimer

The findings and conclusions in this paper are those of the authors and do not necessarily represent the official position of the National Institute for Occupational Safety and Health, Centers for Disease Control and Prevention. Mention of any company or product does not constitute endorsement by NIOSH.

References

A list of references is available in the full paper.