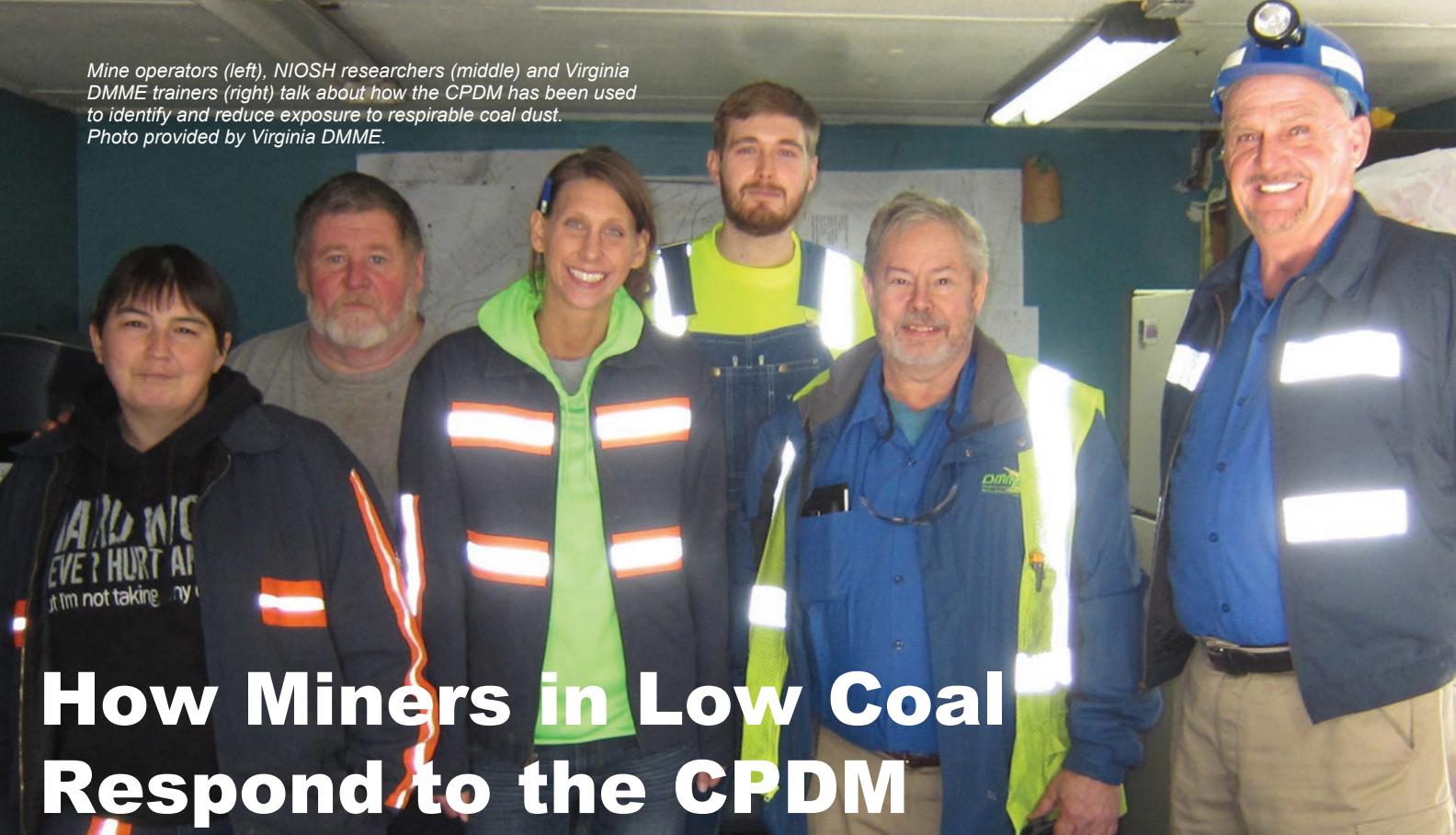


Mine operators (left), NIOSH researchers (middle) and Virginia DMME trainers (right) talk about how the CPDM has been used to identify and reduce exposure to respirable coal dust. Photo provided by Virginia DMME.



How Miners in Low Coal Respond to the CPDM

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As the relatively new respirable dust regulation (30 CFR Part 70) completes its phase-in process at coal mines, we still have much to learn about the challenges of maintaining compliance and controlling dust sources. Beginning on February 1, 2016, coal mine operators were required to begin collecting respirable dust samples using continuous personal dust monitors (CPDMs) for designated occupations (DO) and "other" designated occupations (ODO). On August 1, 2016, the maximum allowable concentration limits for DOs and ODOs at the working face were reduced to 1.5 mg/m³. During this time frame, National Institute for Occupational Safety and Health (NIOSH) researchers have been studying the response to and application of this technology from various viewpoints. Recently, NIOSH completed a series of low-seam coal mine visits in cooperation with the Virginia Department of Mines, Minerals and Energy. The goal of these visits was to understand what unique challenges may exist for those DO and ODO miners who are required to use the CPDM while working in low coal (approximately 43 inches) (Mine Safety and Health Administration [MSHA], 2009), in comparison to miners who work in coal seams over 60 inches.

In 2015, 305 underground coal mines produced 306,821,000 tons of coal (US Energy Information Administration, 2015), of which approximately 15% was mined in seams under 43 inches. It is widely acknowledged that miners who work in low-seam operations face different challenges than those who operate in a seam that allows them to stand and offers more mobility. Mainly, continuous mining operators (CMOs) and roof bolters, both falling within the DO or ODO categories, spend their shifts in kneeling and squatting postures (NIOSH, 2011). Further, the CPDM worn on the miners' belts (per 30 CFR Part 74.7) adds 2 kg to the weight being carried and could be more difficult to read in a crouched position, so the question arises as to how these low-seam coal miners will perceive this technology.

To examine this issue, NIOSH asked miners, mine operators, and dust technicians various questions about individual worker and organizational responses to the CPDM as it became part of their job. Some of the primary findings are discussed to allow industry stakeholders and technology manufacturers to consider this sometimes forgotten, yet significant group of miners

when designing and tweaking similar technologies.

Challenges with Confined Space and Mobility

As expected, miners who work in low-seam coal shared their frustrations with the additional ergonomic challenges that the CPDM introduces into their workday. Those miners who are smaller in stature have an even harder time fitting the CPDM around their miners' belt while also wearing their self-contained self-rescuer (SCSR), proximity PWD, and other required tools. Also, in some situations roof bolters cannot wear the CPDM while pinning; rather, they have to put it on the bolting machine's platform. Similarly, shuttle car operators (SCOs) have difficulties loading with the CPDM on their belt. Since there is not enough room on the deck and the roof is too low for canopies, they tend to set the CPDM next to them on their seat. However, in the shuttle car, the noise and vibration can sometimes affect the operation of the CPDM. Similarly, CMOs mentioned the difficulties they have navigating and moving around in low seams with bulky objects around their neck and waist, such as their remote miner controller, the

CPDM, and SCSR.

Acknowledging these mobility and space constraints, many low-seam miners who NIOSH talked with said they were hesitant to change their work practices even to avoid dust exposure. One CMO said, "I know I should move but I just don't because it's pretty difficult to resituate and still do my job." One CMO went into more detail when he discussed a scenario that he knows exposes him to higher levels of coal dust:

"The water sprays are good, but when coal is being loaded off of the conveyor onto the boom you have to run and even with the water on there's a good bit of dust. You have to move back. But for us that means we roll or crawl. It's very tough. You just can't crawl in time. It's easier to react when you're standing. Just remember, low coal people are less apt to move. We stay in one spot."

CMOs and roof bolters also discussed times that they stayed in one spot to avoid any technical problems with the CPDM. They relayed problems with their CPDM hoses crimping or tearing as a result of movement, which can lead to the CPDM registering a "status code" and the sample potentially being voided by MSHA after examining the CPDM data file and use criteria. A similar issue was discussed with the lapel piece of the CPDM being covered when they changed positions. Miners said that if anything goes over the lapel opening for a prolonged period of time (around two minutes), the CPDM again would register a status code and potentially void the sample. With no alerts to warn miners that their hose is crimped or the lapel is covered, they are often unaware that they need to change their position. After replacing torn hoses or having to wear the CPDM for an additional number of days, miners said that they were more apt to stay in one place to avoid any CPDM-related sampling problems.

To maintain normal mobility at these low-seam mines during CPDM sampling, a common compromise for miners was to have their SCSR within 25 feet of where they were working in order to comply with regulations, noting that wearing the SCSR and CPDM at the same time made it unmanageable to crawl in the mine. These issues were faced by everyone when they first started wearing the CPDM. However, several miners eventually opted to make a conscious effort to teach themselves and make changes based

on the CPDM after seeing higher-than-expected dust data readouts, albeit still within compliance.

Miners Taking Control to Reduce Dust Sources

A majority of miners noted that they checked their CPDM periodically, but not every 15 or 30 minutes. As one miner said, "Basically just the concentration for the shift and comparing it to the limit. But, I have to operate the miner a certain way in a certain position anyway. CMOs have little control here." However, a CMO at one of the low-seam locations was able to make changes using this device. A dust technician said, "I showed him his initial readings with the CPDM that were over 1.0 mg/m³ because we don't want anything over 1.0 mg/m³. He experimented with it and he moved himself to different areas. He's in a better range now, he learned a lot, and he feels better." Those miners who tested their exposures in different areas and checked the display concentrations noted that, even though it was hard to react in the moment due to their mine environment, they were able to be more proactive the next day when they knew a task was approaching that would result in higher dust exposure.

Additionally, roof bolters were able to learn about their biggest dust sources and take steps to reduce unnecessary exposures throughout the workday. For roof bolters, cleaning the dust boxes upwind is a common, well-known dust-producing task. Accordingly, organizations have changed work practices after seeing just how high exposure peaks for roof bolters can be on their dust data readouts. Now, roof bolters alternate changing bags so that one person is not getting all of the unavoidable dust exposure. Although this may sound like an intuitive work practice, many miners indicated that they became more aware of tasks within their daily routine that produce higher levels of dust through their CPDM readings and, consequently, altered their work practices.

Finally, miners discussed the role of the CPDM in revealing specific circumstances in their mine that are critically important to controlling their dust exposure. They discussed things such as tight line curtains, adequate ventilation, and ample water pressure as having the biggest impact on their health throughout the workday. As one miner said, "You are always producing a dust cloud. So

you move when you can whether it's out of the dust or across the intake where there's not as much pressure."

The Role of Management in Facilitating and Maintaining Dust-reducing Practices

NIOSH heard from members of mine management about their experiences with encouraging and trying to maintain work practices that minimize exposure to respirable dust. First, many mines took the initiative to send all of their employees to the CPDM training at a local MSHA district office so they could better understand the capabilities and limitations of the technology. This action also granted every employee a certification to run the CPDMs. Managers felt that providing this extra background knowledge to employees helped build overall dust awareness within their workforce.

In addition, managers and dust technicians discussed what they learned about dust exposure of ODOs (e.g., positions other than the CMO). One individual said:

The roof bolter is at a bigger risk for black lung than the CMO. The problem is that the CMOs, they got black lung hammered into them and the dangers of it. They're more aware. We've left the roof bolters behind, haven't paid the attention to their health that's been needed. And of course for the roof bolters their risk is more silicosis, which is worse than black lung.

This individual continued, reflecting that his company is doing a much better job at keeping the roof bolter out of the return than in the past, based on the CPDM data. Although the dual ventilation system at many sites helps minimize exposure, he said it is imperative to work with roof bolters to change their initial drilling practices. Specifically, when they first start drilling into the first four inches of the roof, the drill suction gets clogged, which blows a large amount of dust out once the obstruction is cleared. To minimize dust liberation from clogged drills, management said that drilling the first four inches more slowly is crucial. Several managers discussed relaying this message to their bolters to help reduce their exposure to respirable dust.

Ultimately, using the CPDMs has allowed members of management to communicate more readily with at-risk

continue

CPDM continued

groups based on miners' attitudes toward coal dust exposure. It was common for managers to say that, at first, everyone liked to look at their dust data readouts. If they asked miners why they had a peak at a specific time, most were able to remember if the incident was recent. However, three issues are readily apparent based on the discussions with managers. Firstly, miners experience complacency after reading and analyzing so many dust data cards and become less interested in time. Secondly, after initial behavioral changes, they may feel unable to make further modifications without impacting their job further. Finally, it is critical to motivate younger workers to care about their exposure to respirable dust and educate them about its long-term health effects.

Managers also said that non-confrontational discussions about any readouts that are over 1.0 mg/m³ are important. Additionally, they said that asking their workforce about what the final number over an 8-hour period means is imperative to help support the maintenance of behaviors during times when they are not required to wear the CPDM. As one manager said, "It's a culture. I think they're changing behavior for health reasons and compliance reasons. Even though it's a little of both I just want it to be maintained.' Therefore, even if day-to-day processes do not or cannot change very much due to the constraints in low-seam mines, the communication and support offered by management through education about their dust readouts can help support a slow shift in perceptions. This could eventually empower and sustain routine practices that may be viewed as

daunting among workers right now, such as crawling, rolling, and slowing down practices.

Moving Forward with the CPDM

With these benefits and challenges in mind, it is clear that these low-seam miners, like other miners, appreciate the real-time dust information. It was common for operators to reflect back on times that they received a notice that they had a bad sample 30 days earlier and had no idea what they were doing at that time. The ability to know exposures in real-time has empowered health and safety practitioners in the industry. However, there are also barriers faced in low-seam mines that further impede miners' abilities to respond accordingly.

First, to avoid any voided samples due to crawling or moving, most miners noted that they would rather stay in one spot than risk starting their sampling period all over again. Continuing to tweak the technology to meet the constraints of this specific environment and spending more time understanding the differences among low-seam miners' work tasks could help improve the design of the technology and support this group of workers in modifying some of their practices. Second, several managers and miners expressed concerns about the CPDM taking attention away from their work task due to nervousness about compliance. In response, while getting used to what the CPDM dust data means, miners labeled the technology as an unintentional hazard on the job. Continued participation in the CPDM certification trainings may help minimize any questions and doubts miners have on the job when looking at their real-time dust levels. However, even if knowledge

and awareness are high among the workforce, maintaining the knowledge that any dust exposure is harmful will be important to continually reduce personal dust sources.

Although there is still a learning curve about what impact this technology is having on healthier work practices within the mining industry, highlighting the interactions of an often forgotten group is essential to enhance understanding. Moving forward, finding a balance of healthy work practices and compliant work practices is important. Looking past the initial technological and environmental hurdles in obtaining 15 good samples, the industry recognizes the importance of the information this technology can offer. As one miner said, "I think this has helped us stay out of the dust. It's just hard when you have a bad day.'

Disclaimer: The findings and conclusions in this paper are those of the authors and do not necessarily represent the views of the National Institute for Occupational Safety and Health (NIOSH). Mention of any company or product does not constitute endorsement by NIOSH.

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