Grant: AFC820-50

Title: Integrating Real-Time Personal Dust Exposure Monitoring with Location Tracking

Organization: Colorado School of Mines

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Topic: Health and Safety Interventions

Priority Area: Dust and Toxic Substance Control and Monitoring Systems and Integrated Control Technologies

SYNOPSIS

Problem Statement: Mine workers continue to suffer from overexposures to respirable dust, with debilitating health consequences that eventually lead to death. Colinet et al. (2010) found the prevalence of coal workers' pneumoconiosis (CWP) to be increasing between 2000 and 2006, showing CWP in almost 8% of underground coal miners who had >25 years of experience. The National Academies (2018) report on "Monitoring and Sampling Approaches to Assess Underground Coal Mine Dust Exposures" documents that, since 2002 and especially since 2010, there have been significant increases in the prevalence of CWP in U.S. miners who have 15 or more years' tenure in coal. The report urges developing new technologies that enable area monitoring in addition to real-time personal exposure monitoring. CWP is a debilitating, often fatal disease. Despite having a near real-time dust exposure vs. time record from the Personal Dust Monitor (PDM) 3700, miners' working locations are not tracked along with their associated dust exposure levels. Location monitoring and tracking is necessary to identify sources and areas of excessive dust exposure, to predict hazardous exposure levels and to implement mitigating engineering and administrative controls before a miner is exposed.

Research Approach The proposed research is a proof-of-concept to add geolocating capability to the PDM to obtain spatio-temporal dust exposure mapping to improve engineering and management controls for mine dust control. Offeror will obtain a PDM 3700 unit from Thermo Fisher Scientific. Researchers will then add geolocating and georeferencing capability to the PDM by extracting location information from a given miner tracking system. Underground mines typically use Leaky-Feeder, Wi-Fi or RFID tracking systems while in surface locations, GPS is available. The proposed georeferencing technology will work with all miner tracking systems. It combines personal, near-direct reading dust measurements with area sampling through recording the exposure locations. According to the National Academies (2018) report, conventional, stationary or machine-mounted area dust samplers have the disadvantage that exposure information do not relate to the presence of miners in the sampling area. The proposed solution overcomes this drawback and produces location and exposure information directly related to the presence of a miner and to the exposure area. Respirable dust exposure is a complex phenomenon related to mining activities, dust sources, operational conditions and individual pre-exposure characteristics. Researchers will develop an artificial intelligence (AI) model to evaluate and predict dust exposure for a specific operational location and activity along with appropriate data visualizations. This information may then be used to design engineering and administrative controls to reduce or eliminate respirable dust exposure among miners, plant and factory workers. Moreover, the combined use of heat map and the AI model will allow design of effective risk reduction related to respiratory illnesses.

Impact of the Research: Following successful demonstration in the proposed project, researchers expect that location tracking technology will be integrated into future evolutions of the Personal Dust Monitor. Tracking technology is already used in all underground coal mines and combining it with the PDM is a relatively simple step. Having the ability to pinpoint locations of dust overexposures will lead to better, more effective engineering controls and dust management and result in significant drops in CWP, black lung and other respiratory diseases among coal miners.