Project Title: The Application of Flooded Bed Dust Scrubbers to Longwall Mining Systems

Organization: University of Kentucky

Partnerships: Alliance Coal, LLC
Joy Global
NIOSH Office of Mine Safety and Health Research

Investigators: Thomas Novak (PI),
Joseph Sottile (Co-PI)
William C. Wedding (Co-PI)

Focus Area: Safety and Health

SYNOPIS

***Problem Statement and Justification*:** Dust is a detrimental, but inherent, consequence of any mining process and is particularly problematic in underground coal mining. Coal workers' pneumoconiosis is a debilitating and irreversible lung disease resulting from long-term overexposure to respirable coal dust. Although its prevalence has steadily and significantly declined since the Federal Coal Mine Health and Safety Act of 1969, NIOSH indicates that health hazards associated with *respirable dust* still exist. Coal dust can also create a potentially catastrophic safety hazard. Airborne dust, if not removed near its source, is transported and dispersed downstream throughout a mine by the ventilation airstream. This dust, known as *float dust*, is subsequently deposited on all surfaces as it permeates through mine airways. A potential safety hazard occurs if an insufficient amount of rock dust is applied to mine surfaces, and the settled coal dust is not adequately diluted to an inert mixture. If a methane ignition occurs, its resulting shockwave propels the settled dust into the airstream, creating an explosive dust cloud. The initial methane ignition can then transition to a dust explosion that propagates throughout mine airways until its fuel (explosive dust) is exhausted.

Impact of the Research: The ultimate goal of the proposed project is to design and fabricate a functional prototype scrubber system with high capture and cleaning efficiencies that can be incorporated into a longwall mining system. Therefore, capturing and removing coal dust at its source will mitigate the probability of two major dust hazards that continue to plague the mining industry.

Objectives and Research Approach: Longwall mines, which account for approximately one-half of the coal produced by underground mines in the U.S., exhibit greater difficulty in maintaining compliance with federally mandated dust regulations, compared with continuous mining operations. Therefore, the project effort is directed toward application of a flooded-bed dust scrubber to a typical U.S. longwall system. Futhermore, the research will only focus on the application of a scrubber to the headgate side of the shearer, thus increasing the probability of success for this initial effort. Air-quantity and dust measurements made at various locations along the longwall face will be utilized to construct computational fluid dynamics models to depict airflow patterns that occur along the longwall face and shearer. A scaled physical model will be constructed to verify the accuracy of CFD models. These models will then be used to determine the capacity requirement of the scrubber, as well as the optimum locations for the inlet and discharge of the scrubber. The placement of deflection curtains, created by water sprays and/or physical material, will be analyzed for helping direct the dust cloud toward the scrubber inlet and minimize dilution by the ventilation airflow. Conceptual designs will be developed and the capture and cleaning efficiencies for these prototypes will be tested at the NIOSH's longwall dust gallery in Pittsburgh, Pennsylvania. If the test results are positive, discussions will be held with the mining-machine manufacturer to investigate further refinement, development, and incorporation of the system into their shearer design.