

An Evaluation of Pyrite as a Component of Respirable Coal Dust

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Abstract: As coal worker's pneumoconiosis has increased over the past two decades, researchers have evaluated the potential effects of coal, quartz, and other minerals as components in respirable coal dust. Pyrite is found in many coals, though in varying quantity and in different forms, for example, crystalline or framboidal. The oxidation of pyrite produces $\bullet\text{OH}$, a reactive oxygen species (ROS) thought to cause the toxicity of the dust once in the lung. In this study, we used fluorescence values for $\bullet\text{OH}$ and tested additives to inhibit $\bullet\text{OH}$ production across different pH levels with different coal pyrite samples. Promising candidates were evaluated in various solutions, including tap and process water and simulated lung fluid. The pyrite surface was assessed using electro-kinetic measurements and infrared and X-ray photoelectron spectroscopy that indicate the presence of different impurities in the pyrite. Density functional theory simulations suggested the mechanisms of interactions on the pyrite surface. This research enhances our understanding of the potential health effects of coal pyrite and ways to reduce the $\bullet\text{OH}$ on the surface of pyrite.