Investigation on Coal Dust Explosion Characteristics and its Influcing Factors Using 20L Spherical Vessel

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Abstract

Coal dust explosion in the coal mine is one of the serious hazards for the coal production industry. To understand the effect of particle size and size dispersity (σ_D) on the explosibility characteristics of coal dust, special designed experiments considering the effect of coal dust size and size dispersity (σ_D) for coal dust explosion have been conducted using 20 L spherical explosion vessel. The explosion characteristics of coal dust samples with different rank were investigated. The co-effects of particle size & size dispersity, particle size & dust concentration were analyzed. Results show that coal dust explosion hazard and severity should be considered not only by dust concentration, but also particle size (D_{50}) & size dispersity (σ_D). Pmax and $(dP/dt)_{max}$ show an increasing trend in explosion severity parameters as size dispersity (σ_D) and particle size (D_{50}) decreasing. The maximum explosion pressure (P_{max}) and the maximum rate of pressure rise $(dP/dt)_{max}$ both undergo an initial growth and then decrease with the increase of coal dust concentration. Interestingly, all samples' optimum concentrations corresponding to the maximum explosion pressure (P_{max}) are almost at the same concentration of 250 g/m^3. P_{max} and $(dP/dt)_{max}$ values are closely related to the fraction of fine particles suspended in the dust cloud. Coal dust characterized by similar D_{50} but with larger size dispersity (σ_D) always presents less explosibility than that of coal dust with smaller size dispersity (σ_D), especially for the maximum rate of pressure rise $(dP/dt)_{max}$ at higher dust concentration ranges (> 250 g/m^3). Due to the difference of coal rank and volatile matter contents, the optimum explosion zones (with severe explosion hazard) of different coal dust vary greatly. Coal dust with higher volatile matter contents would present better deflagration properties and produce a higher explosion severity. From the SEM analysis of coal dust explosion solid products), it can be found that coal dust with more volatile matter content is more reactive and the pore shape in the surface of the post-explosion solid particles tending to be more circular and bigger. The optimum zones of coal explosion are mainly controlled by both particle size and dust concentrations. under the optimum concentration ranges, the finer coal particles always produce higher explosion pressure (P_{max}).

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