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The quantitative studies on gas explosion suppression by an inert rock dust deposit

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Highlights:

- The process of the rock dust cloud barrier forming is demonstrated.
- The characteristics of the explosion field at different deposited rock dust amounts are investigated.
- The lower limit of the deposited inert rock dust amount is researched.
- The suppression effects begin to weaken when the deposited rock dust amount increases to a certain value.

Abstract: The traditional defence against propagating gas explosions is the application of dry rock dust, but not much quantitative study on explosion suppression of rock dust has been made. Based on the theories of fluid dynamics and combustion, a simulated study on the propagation of premixed gas explosion suppressed by deposited inert rock dust layer is carried out. The characteristics of the explosion field (overpressure, temperature, flame speed and combustion rate) at different deposited rock dust amounts are investigated. The flame in the pipeline cannot be extinguished when the deposited rock dust amount is less than 12 kg/m³. The effects of suppressing gas explosion become weak when the deposited rock dust amount is greater than 45 kg/m³. The overpressure decreases with the increase of the deposited rock dust amounts in the range of 18-36 kg/m³ and the flame speed and the flame length show the same trends. When the deposited rock dust amount is 36 kg/m³, the overpressure can be reduced by 40%, the peak flame speed by 50%, and the flame length by 42% respectively, compared with those of the gas explosion of stoichiometric mixture. In this model, the effective raised dust concentrations to suppress explosion are 2.5-3.5 kg/m³.

Keywords: Deposited rock dust; Overpressure; Temperature; Flame speed; Flame length

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