Study on the heat removal efficiency of thermal probe on coal storage heap under the different ambient air velocity and arrangement

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A B S T R A C T

In recent few decades, the spontaneous combustion of large-scale coal storage heap is frequently and the ambient airflow is one of the reasons that induced it occurred, which is seriously caused the waste of resources and environmental pollution. However, the existed prevention and control technologies of coal storage heap still have highly cost and poorly effect problems. In this paper, based on the principle of heat removal by thermal probe, we thus have a simulated experiment to study the heat removal radius (R), axial difference in temperature ($\Delta^{o}C$) in heat removal zone, and the variation of cumulative heat transformation ($\Sigma\Delta T$) into coal storage heap as its internal temperature are 100 ℃ and 150 ℃ that under different experimental conditions, such as the angle of thermal probe inserted into the coal storage heap are 45, 60, and 90 degrees,

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respectively, and then the outside ambient air velocity are 0 m/s, 1.5 m/s， and 2 m/s, respectively. The results revealed that the scale of drop in temperature of designated point in the coal storage heap are 46.3%, 10.8%, and 32.8% that under the above experimental conditions, respectively. Thus making a comparison found that as the inserted angle of thermal probe in the coal storage heap is 45 degrees, the heat removal efficiency of thermal probe is significantly affected by outside environment, and also its airflow sensitivity is more stronger. Furthermore, while the inserted angle of thermal probe is varied, the heat removal efficiency is more significant. For instance, when the outside air velocity and inserted angle of thermal probe are 0 m/s and 60 degrees, the average radius of heat removal is 5.79 m (maximum heat removal radius), the axial difference in temperature is 1.2 ºC (minimum axial difference in temperature). Meanwhile, compared with the inserted angle of thermal probe is 45 and 90 degrees, the heat removal efficiency of thermal probe in a 60 degrees inserted angle is increased by 11.6% and 87%, respectively. In addition, as the outside air velocity is 1.5 m/s and 2.0 m/s, respectively. the average radius of heat removal ($\bar{R}$) and axial difference in temperature ($\Delta^{o}C$) is obviously smaller than that of air velocity is 0 m/s. Therefore, it can be concluded that the suitable inserted angle of thermal probe is advantageous to heat removal, and when the angle between the thermal probe and airflow is 60 degrees, the axial difference in temperature is minimum, and the efficiency of heat removal is most highest. This paper provided a new technical approach and theoretical basis for the prevention and control of coal spontaneous combustion for large-scale coal storage heap that under an airflow condition.

43 *Keywords*

44 Coal storage heap; Thermal probe; Heat removal efficiency; Ambient air velocity;

45 Arrangement