A Novel Approach for Predicting the Incubation Period of Spontaneous Combustion of Coal based on Thermogravimetric Analysis（TGA）

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Abstract: Accurately predicting the incubation period of spontaneous combustion is of great significance to the prevention of coal self-ignition. In order to overcome the disadvantage of long test period of the adiabatic oxidation methods, in this paper, the composite reaction behavior of coal and oxygen were carried out in a thermogravimetric analyzer under different constant temperature conditions and multiple heating rates (1, 2,4 and 8 $K \cdot min^{-1}$) with temperature rising from ambient temperature to 800℃. A novel approach for predicting the incubation period of spontaneous combustion of coal was then proposed. Firstly, based on Starink isoconversion method and its transformation formulas, the relationships between apparent activation energy , pre-exponential factor and conversion rate as well as the reaction model under different conversion rates of coal in the water evaporation stage and the oxygen absorption stage were determined. Then, the relationships between temperature and conversion rate of coal in the water evaporation stage and the oxygen absorption stage is obtained respectively based on the constant temperature experiments. Finally, the above obtained results were substituted into the prediction model which was transformed from Arrhenius rate equation to calculate the reaction time of coal in the water evaporation stage and the oxygen absorption stage respectively, and the sum of the two reaction time was the incubation period of spontaneous combustion of coal. This approach has the advantages of short test period and good repeatability.

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