

Investigation of thermal properties and Burning Behaviour of Australian Hunter Valley Coal Dust

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ABSTRACT

The risk of coal dust fire and explosion enhances the demand of precise risk analysis of coal dust combustion. A better understanding of coal dust fire and explosion hazards would greatly assist to provide an effective protection approach to avoid such a fire and explosion. The aim of this work, is to address the thermal and explosion characteristics from three aspects, first, examine the minimum ignition energy (MIE) and the minimum ignition temperature (MIT) required to initiate the combustion process, then measure the explosion characteristic, and examine the burning behaviour of samples. The experimental work conducted on two different coal dust samples collected from a Hunter Valley mine site (Australia). The thermal and explosion characteristics of the coal dusts were examined by employing a variety of relevant apparatus such as cone calorimeter and 20 L explosion chamber. Results corresponding to this study indicated a significant discrepancy between the fire and explosion characteristics of these two samples due to their particles compositions. The dust layer MIT of Sample A was 270 °C which is lower than the dust layer MIT by about 110 °C, also, Sample A required only 251 mJ to ignite, however Sample B required 740 mJ. Both sample A and B exploded using 1 kJ ignition energy, however, the maximum pressure rise was achieved at 450 g.m⁻³. Finally, the fire test results of Hunter Valley coal dust at 50 kWm⁻² heat flux shows that the peak heat release rates of sample A was 93.139 kWm⁻² as compared to 83.185 kWm⁻² for sample B, the combustion reaction consumed 63.231 g and 76.017 g of oxygen, respectively, for samples A and B.

Keywords: heat release, coal combustion, fire, explosion, auto ignition, fire testing.