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Dust Explosibility and Severity of Bayan and Tanito Coal

The assessment of the explosibility and severity characteristics of Bayan coal and Tanito coal was investigated over various concentrations in a 20 L Siwek spherical explosion chamber. The coals tested in this study were also compared with other organic dusts such as palm-based soap noodle, tea powder, black rice, and rice flour, which were tested using the same explosion chamber and procedures. The severity and explosibility of the coals increase as their concentration increases. The P_{max} of Bayan coal (10.15 bar) is higher than that of Tanito coal (7.35 bar). The K_{st} of Bayan coal (48.04 bar m s^{-1}) is also higher than that of Tanito coal (16.83 bar m s^{-1}). Among all the dusts studied using the same chamber and procedures, palm-based soap noodle has the highest P_{max} at 16 bar, while tea powder has the lowest P_{max} at 6.35 bar. The results show that the explosibility and severity of the coals increase as the concentrations increase, and the moisture content, coal ranking, and different types of organic dust have a significant influence on the severity characteristics of dust explosions.

Keywords: Combustion time, Deflagration index, Dust explosion overpressure, Explosibility and severity, Flame propagation speed

Received: October 31, 2023; *revised:* May 04, 2024; *accepted:* May 13, 2024

DOI: 10.1002/ceat.202300514

1 Introduction

Despite the concerns to replace natural energy resources with renewable energy sources due to co_2 emission and natural resource depletion [1], the consumption of coal as energy source in power plant is still dominant. According to an incident report by Cloney [2], 51 people have died, and more than 100 people were injured in the Russian coal mine explosion that happened on November 25, 2021. Even though the scale of the coal mining industry is relatively small in Malaysia compared to other countries [3], a significant amount of coal dust is still produced in various industries handling of processing such as crushing and transportation, which forms dust clouds in the confined space [4]. As reported by Othman [5], the coal consumption shows an increasing percentage in Malaysia's electricity generation, from 7.2 % (1999) to 42.8 % (2019). Explosion accidents invariably lead to severe economic losses, irreparable family disruptions, and significant international repercussions. Hence, it is imperative to promptly devise stringent measures and highly efficient techniques for predicting and preventing pulverized coal explosions [6]. It is indispensable to find out the physicochemical properties including the dust severity and explosibility analysis to implement an efficient system for the protection and mitigation of dust explosion in industries. Different properties of coal dust such as moisture content and particle sizes may influence the explosibility of the coal dust [7–10]. Therefore, understanding the minimum explosibility of dust concentration (MEC) is crucial as it helps to quantify the potential formation of an explosible dust cloud during coal dust operation or transportation. In this study, dust deflagration index (K_{st}), flame propagation speed (v_F), and maximum explosion overpressure (P_{max}) are also investigated on Bayan and Tanito coal. The concentration of dust has a considerable impact on the severity of dust. When the dust concentration increases, explosion overpressure also increases until it reaches an optimum concentration due to the variation in the distribution of dust. When the dust concentration increases, the chemical reactions and combustion efficiency would be greatly affected by the effective surface area of dust, hence resulting in the increase in flame propagation and explosion severity

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