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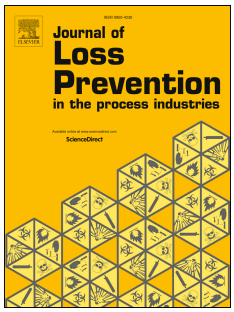

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Effect of sample orientation on fire hazard of non-metallic dust layers exposed to electric sparks

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Abstract:

Surface flames are far stronger as dust explosion ignition sources than smoldering agglomerates, but surface fire seldom occurs with horizontally deposited non-metallic dust layers. In this paper, the effects of sample orientation on the fire hazard of four non-metallic dust layers were investigated using electric spark ignition. Layer surface inclination angle significantly influenced layer ignition sensitivity and fire hazard. For PMMA dust layers, flame spread velocity (FSV) reached 2.6 mm/s from 0.8 mm/s when the inclination angle was increased from 0° to 50°, while in wood dust layers, sustainable propagating combustion occurred when the inclination angle was increased to 40°. Also, the maximum temperature and FSV of surface fire in wood dust layers were far greater than these of smoldering fires, indicating a greater fire hazard for surface fire. Angle of inclination of combustible powder deposits should be considered when assessing fire and explosion hazard in real process industry situations.

Keywords: dust explosion; dust layer; sample orientation; fire hazard; electric spark

1. Introduction

Diffusion deposition of fine dust is a common phenomenon in the powder process industries (Klippel et al., 2015). When the surface layers of dust deposits are subjected to common ignition sources (*e.g.*, electric sparking), ignition occurs at the surface instead of the lower layers, thereby producing flaming rather than smoldering agglomerates or nests (Eckhoff, 2003; Wingerden et al., 2011; Rogers et al., 2006). These references demonstrate that flaming nests are far stronger ignition sources of dust explosions than smouldering agglomerates (Gummer and Lunn, 2003). Other recent investigations have shown that metallic powders have a high layer fire hazard when exposed to electric sparks, with consequent significant potential to result in violent dust explosions (Yuan et al., 2017; Beloni, 2009, 2012). The surface layer fire hazard for