

Accepted Manuscript

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PII: S0032-5910(17)30896-3
DOI: doi:[10.1016/j.powtec.2017.11.026](https://doi.org/10.1016/j.powtec.2017.11.026)
Reference: PTEC 12945

To appear in: *Powder Technology*

Received date: 15 August 2017
Revised date: 3 November 2017
Accepted date: 8 November 2017



Please cite this article as: Qi Zhang, Lijuan Liu, Shilei Shen, Effect of turbulence on explosion of aluminum dust at various concentrations in air, *Powder Technology* (2017), doi:[10.1016/j.powtec.2017.11.026](https://doi.org/10.1016/j.powtec.2017.11.026)

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Effect of turbulence on explosion of aluminum dust at various concentrations in air

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Abstract:

Energy released in explosion of aluminum dust at a given concentration in air depends on pre-ignition turbulence. The combined effects of turbulence and concentration on aluminum dust/air explosion in a 20 L spherical vessel were examined by numerical calculation in this study. It is found that role of pre-ignition turbulence in the aluminum dust/air explosion is related to the nominal concentrations. At lower nominal concentrations, the turbulence is a dominant factor affecting an aluminum dust/air explosion over uniformity of aluminum dust suspended in air. However, at higher nominal concentrations, the uniformity of aluminum dust suspended in air is a dominant factor affecting an aluminum dust/air explosion over turbulence.

Keywords: Aluminum dust; Turbulence; Uniformity; Explosion

1. Introduction

Aluminum powder has a higher energy density, specifically as a ratio to its volume, than other conventional fuels and is used widely in process industries [1]. Previous flammability data of aluminum dust have mostly focused on flammable sensitivity parameters (minimum ignition energy and minimum flammable concentration) and combustion severity characteristics (maximum combustion pressure and maximum rate of pressure rise) [2-6]. In fact, energy released in aluminum dust/air explosion is varied with the initial conditions. The pre-ignition turbulence and

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