Scaling of Metal Dust Explosions

Kees van Wingerden\textsuperscript{1} and Scott Davis\textsuperscript{2}
\textsuperscript{1}GexCon AS, Fantoftvegen 38, Bergen, Norway
\textsuperscript{2}GexCon US Inc, Bethesda, MD, USA
Presenter E-mail: kees@gexcon.com

Key words: dust explosion, explosion characterization, method/standard

Abstract

Dust explosions hazards have been addressed in a number of standards and guidelines aiming at supporting industry to work safely (including NFPA 61, 68, 69, 654 and 484). These standards are partly based on research carried out through the years. Experiments have been carried out, with many being conducted on the large scale, to understand how dust explosions develop and progress. Protective systems have also been developed and tested to reduce the potential consequences of dust explosions. The overwhelming majority of these experiments were conducted with organic dusts, and very little work has been performed using metal dusts.

Metal dust explosions may behave differently from organic dust on large scale due to the contribution of radiation to the flame propagation mechanism. Radiation levels caused by especially light metal flames can be very high due to high flame temperatures. The incident radiation at a position ahead of the flame is related to the size of the flame ball, and hence it is scale dependent. This paper presents a theory demonstrating that flame propagation rates in clouds of light metal dusts are expected to be scale-dependent and that a $K_{ST}$-value determined in a 20-l sphere may underestimate dust explosion effects on an industrial scale. The paper presents a review of large-scale dust explosion experiments performed with metal dusts supporting the theory.