Dust from industrial-scale processing of nanomaterials carries high explosion risk

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With expanded industrial-scale production of nanomaterials fast approaching, scientists are reporting indications that dust generated during processing of nanomaterials may explode more easily than dust from wheat flour, cornstarch and most other common dust explosion hazards. Their article in ACS' journal *Industrial & Engineering Chemistry Research* indicates that nanomaterial dust could explode due to a spark with only 1/30th the energy needed to ignite sugar dust — the cause of the 2008 Portwentworth, Georgia, explosion that killed 13 people, injured 42 people and destroyed a factory.

Paul Amyotte and colleagues explain that dust explosions are among the earliest recorded causes of industrial accidents — dating back to a 1785 flour warehouse disaster — and are still a constant threat at facilities that process fine particles of various materials. Despite significant research, there is still much for scientists to learn about the risks of dust explosions in industry, especially of so-called "nontraditional" dusts (such as those made of nanomaterials), and a constant threat exists. That's why the researchers decided to probe the explosibility of three types of nontraditional dusts: nanomaterials; flocculent (fibrous or fuzzy) materials used in various products, such as floor coverings; and hybrid mixtures of a dust and a flammable gas or vapor.

After reviewing results of studies that exist on the topic, the researchers concluded that the energy needed to ignite nanomaterials made of metals, such as aluminum, is less than 1 mJ, which is less than 1/30th the energy required to ignite sugar dust or less than 1/60th the energy

required to set wheat dust aflame. Flocking is often made with a process that generates static electricity, which could set off an explosion of flocculent dust, they point out. And the addition of a flammable gas or vapor to a dust as a hybrid mixture increases the chance that the dust will explode. The researchers warn that precautions should be taken to prevent these materials from exposure to sparks, collisions or friction, which could fuel an explosion.

More information: Review of the Explosibility of Nontraditional Dusts, *Ind. Eng. Chem. Res.*, Article ASAP. DOI: 10.1021/ie201614b

Abstract

This paper explores the explosion characteristics of three nontraditional dusts: nanomaterials, flocculent materials, and hybrid mixtures. Nanomaterials have a high likelihood of explosion with minimum ignition energies potentially less than 1 mJ. These low ignition energies may therefore allow nanomaterials to ignite due to electrostatic sparks, collision, or mechanical friction. The severity of nanomaterial explosions is affected by agglomeration and coagulation of the particles. Flocculent materials with a high length-to-diameter ratio exhibit explosion behavior patterns similar to those for spherical dusts. The length of flocculent particles plays a role in explosion likelihood which is not yet fully understood. High voltage discharge during the electrostatic flocking process is a common flocculent ignition hazard. Hybrid mixtures of a combustible dust and a flammable gas/vapor display a higher explosion severity and a lower minimum explosible concentration than that of the dust alone. Violent hybrid explosions may occur even if the dust and the gas/vapor are below their respective lean limit concentrations.

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