

Combustible dusts: A serious industrial hazard[☆]

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Abstract

After investigating three fatal explosions in manufacturing plants, the U.S. Chemical Safety and Hazard Investigation Board (CSB) has concluded: The explosive hazard of combustible dust is not well known, and helping industry to understand this hazard is a priority.

Prompted by these three incidents in North Carolina, Kentucky and Indiana and the need to increase the hazard awareness, CSB is conducting a study to examine the nature and scope of dust explosion risks in industry and to identify initiatives that may be necessary to more effectively prevent combustible dust fires and explosions. Such initiatives may include regulatory action, voluntary consensus standards, or other measures that could be taken by industry, labor, government, and other parties.

A critical task of the dust study is analyzing past incidents to determine the severity of the problem within industry. The analysis is focusing on the number of incidents, injuries and fatalities, industrial sectors affected, and regulatory oversight. This paper presents the preliminary findings from CSB's analysis of combustible dust incidents over the past 25 years.

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1. Introduction

In 2003, the U.S. Chemical Safety and Hazard Investigation Board (CSB) investigated three major industrial accidents which occurred when fine particles of combustible powders (e.g., dust) were ignited. These explosions – in North Carolina, Kentucky, and Indiana – cost 14 lives and caused numerous injuries and substantial property losses. CSB found that issues related to hazard awareness, regulatory oversight, and effectiveness of fire code enforcement were common to these three accidents. The Board responded by launching a nationwide study to determine the scope of the problem and recommend new safety measures for facilities that handle combustible powders.

On 22 June 2005 at a public hearing held to solicit public input from the regulated community and experts on what changes are needed to reduce the occurrence of combustible

dust incidents,² CSB revealed preliminary research that indicated nearly 200 dust fires and explosions have occurred in U.S. industrial facilities over the past 25 years, resulting in approximately 100 fatalities and 600 injuries. Based on this data and the three CSB investigations, Carolyn Merritt, Chairman of the CSB declared combustible dust incidents are a “serious industrial safety problem”.³ This paper presents preliminary findings that support the statement that the problem is significant.

2. Background

In 2003 the CSB investigated three combustible dust explosions. A total of 14 individuals were killed and 81 injured in these events. In January 2003, an explosion and fire at the West Pharmaceutical Services facility in Kinston, North Carolina resulted

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² CSB defined a combustible dust incident as a fire and/or explosion involving (fueled by) any finely divided solid material 420 μm or less in diameter that has caused or has the potential to cause, serious harm to people, property, or the environment.

³ Part of opening statement for 22 June 2005 hearing on combustible dust hazards. Transcript of hearing can be obtained at <http://www.csb.gov>.

in the deaths of six workers and injuries to 38 others. CSB investigated this accident and concluded that the explosion was the result of the deflagration of polyethylene powder that had accumulated above a suspended ceiling in the processing area of the facility.

In February 2003, a combustible dust explosion occurred at the CTA Acoustics facility in Corbin, Kentucky, killing 7 workers and injuring 37. CSB found that the fuel for the explosion was phenolic resin used to produce insulation and acoustic materials for the automotive industry. The explosion began near a curing oven, where routine cleaning lofted accumulated resin dust that was ignited by fire in an oven on which the doors were left open. Numerous secondary deflagrations caused damage and injuries throughout the facility.

In October 2003, a series of explosions severely burned two workers, injured a third, and caused property damage to the Hayes Lemmerz manufacturing plant in Huntington, Indiana. One of the severely burned men subsequently died. The Hayes Lemmerz plant manufactures cast aluminum automotive wheels, and the explosions were fueled by accumulated aluminum dust, a flammable byproduct of the wheel production process. The report of CSB's investigation into this accident is expected to be approved by the Board soon.

The occurrence of three fatal combustible dust explosions within one calendar year prompted the Board to commence a broader study of the extent, nature and prevention of combustible dust fire and explosion hazards.

3. Dust hazard investigation

A critical objective of CSB's hazard investigation is to determine the number and effects of combustible dust fires and explosions in the United States during the 25-year period beginning in 1980. CSB is excluding the following types of incidents for the purposes of this study:

- Incidents occurring in grain-handling or other facilities that are currently regulated by OSHA's grain handling standard.
- Incidents occurring in underground coal mines.
- Incidents occurring in non-manufacturing facilities such as hospitals, military installations and research institutes.
- Incidents involving transportation or transportation vehicles.
- Incidents occurring outside the United States or U.S. territories.

Other objectives of the study include: evaluating the effectiveness of existing hazard communication programs and regulations in making facility managers and workers aware of the fire and explosion hazards of combustible dusts and determining what additional state, federal or private sector activities may be necessary to prevent future combustible dust fires and explosions.

4. Preliminary findings

CSB has found 197 dust fire and explosion incidents in the United States since 1980, causing 109 fatalities and 592 injuries.

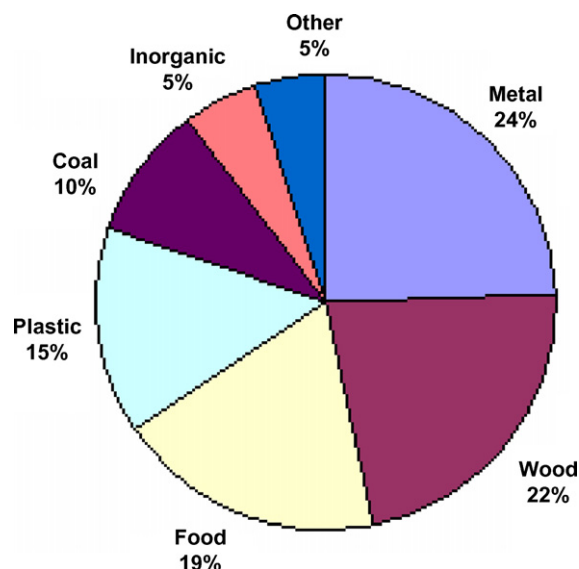


Fig. 1. Type of material involved in dust incidents.

The sources of the incident data include: the Occupational Safety and Health Administration (OSHA) inspection statistics database; the Institute of Chemical Engineers (ICHEME) accident base; Lexis/Nexus; and the National Fire Protection Association (NFPA). CSB will consult other data resources as the data collection efforts continue. The agency anticipates that this effort will uncover numerous other incidents to further support the premise that combustible dust incidents are “serious industrial safety problem”.⁴

Preliminary data analysis conducted on the 197 incidents revealed that various types of material create combustible dust hazards. Fig. 1 breaks down the incidents by type of material.

CSB also uncovered that these fires and explosions occur in many different industries, including rubber and plastic products, chemical manufacturing, primary metal, lumber and wood products, and food products, among others (see Fig. 2).

Furthermore, combustible dust incidents occur nationwide. They are not limited to any one region of the country or a few states. For example, the CSB preliminary data show 21 such incidents in Illinois in the past 25 years, 19 in California, 13 in Ohio, 12 in Indiana, and 11 in Pennsylvania. Table 1 lists the top 12 states for combustible dust incidents.

Other findings of importance include:

- Lack of general awareness about combustible dust hazards throughout industry, including occupational health and safety professionals.
- While some programs to mitigate dust hazards exist at the state and local levels, there is no comprehensive federal program that addresses the problem.

⁴ It is not possible to define the true extent of the problem because small incidents and near misses are often not publicized nor required to be reported to governmental entities. Even for incidents that have information available, the information is often incomplete.

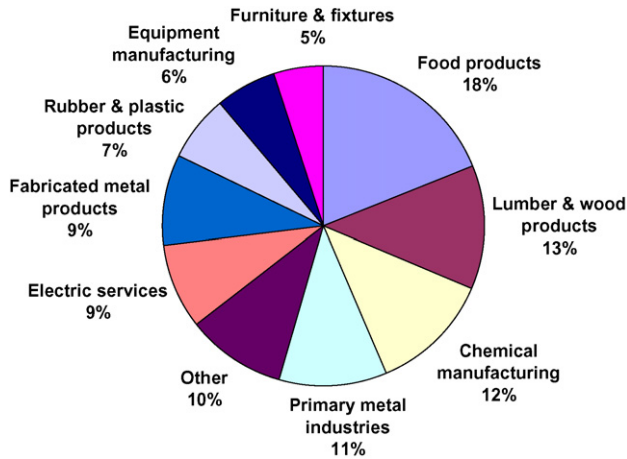


Fig. 2. Incidents break down per industry.

Table 1

Top 8 states for combustible dust incidents (~50% incidents)

States	Number of incidents
Illinois	21
California	19
Ohio	13
Indiana	12
Pennsylvania	11
Iowa	10
North Carolina	8
Maryland	8

- Federal Occupational, Safety, and Health Administration (OSHA) do not have a general industry standard that addresses combustible dust hazards.
- OSHA does not provide a definition for combustible dusts within its Hazard Communication Standard.
- Material safety data sheets (MSDSs) hazard warnings for materials that form combustible dusts did not adequately communicate explosion hazards. In addition, many MSDSs do not communicate the potential hazards of materials that may generate combustible dust as a result or byproduct of processing [3].⁵
- The primary regulatory mechanism for controlling or eliminating combustible dust hazards is enforcement of fire codes by local or state fire code officials. However, CSB found low

general awareness of combustible dust hazards among local and state fire code officials in several states.

- Insurance industry statistics show that combustible dust fires and explosions typically result in substantial property loss. For example,
 - FM Global clients have experienced 455 fires or explosions involving combustible dusts, totaling \$ 483 million in property damage. The average gross loss for dust fires is \$ 1 million and average gross loss for dust explosions is \$ 1.6 million (1991–2000) [1].
 - Industrial Risk Insurers (IRI) database contains 222 combustible dust incidents (1975–2001).
 - Allendale Insurance study (1986–1997) showed that about 90% of the 80 major incidents involved wood dust. Losses totaled close to \$ 141 million in gross damage [2].

5. Summary

Combustible dust hazards pose “a serious industrial safety problem”. Thus far, CSB has found hundreds of combustible dust incidents resulting in large losses of lives, numerous injuries and significant business loss. These incidents occur nationwide involving many different industries and materials. A general lack of awareness of combustible dust hazards exists within industry and there is no national regulatory standard that requires general industry to address these hazards. Furthermore, information available through MSDSs is not adequately conveying hazards associated with combustible dusts.

CSB is actively seeking to find out more information about the scope of the dust problem. A Federal Register Notice soliciting public input was issued in advance of the June 22nd public hearing. Public comments will be collected until the end of this year. After the hazard investigation is complete, CSB will be better able to recommend measures to help avoid dust explosions and fires like those at West, CTA, and Hayes Lemmerz and numerous others uncovered during the data search.

References

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⁵ CSB research conducted as part of the CTA investigation.