



# RESEARCH FOUNDATION

RESEARCH FOR THE NFPA MISSION

## Variables Impacting the Probability and Severity of Dust Explosions in Dust Collectors

Dust collectors are the units of operation where the majority of dust explosion incidents occur. By determining the situations where an incident is most likely to occur or is likely to be severe (both in terms of injury and financial loss), will allow users to focus on the high-risk installations. This will also allow the technical committees to identify any potential gaps in the standards and add requirements to close those gaps. A literature search and review to collect detailed investigations on dust explosion incidents in dust collectors will help determine the key variables that lead to the incidents. Potential sources of data are published literature, e.g., Chemical Safety Board (CSB) incident investigations, and loss history data from insurance companies (if they are shared in the public domain).

### Project Goal & Approach

The primary objective of this study is to identify the key variables leading to dust explosions in dust collectors through a literature review, and analysis of information collected from dust explosion incidents. The analysis will also focus on identifying the variables that are being both more probable and more severe, both in terms of personnel injuries and financial loss.

This project is comprised of the following tasks:

1. List the dust explosion incidents in dust collectors from last 10 years from published literature, news reports, investigation reports and other available resources. Identify any historical/notable dust explosion incidents in dust collectors.
2. Analyze the above incidents and provide an overview of these dust explosion incidents in dust collectors.
3. Identify and summarize the key variables that led to the above incidents. The analysis should also focus on identifying the variables that are being both more probable and more severe, both in terms of personnel injuries and financial loss.
4. Prepare a final report based on the findings from above tasks.

### Summary Observations:

The literature review research attempted to identify variables and contributing factors that led to dust explosion and fire in the production plants. Specific focus of the study was on incidents that included dust collection systems being involved in the incident and took place within the last 10 years. Due to the limited availability of detailed information for most of the incidents, the research was divided into quantitative and qualitative analyses. The quantitative analysis gave a general overview of the fuel type, industry, and the number of injuries and fatalities. The most frequent dust type that involved dust collectors is wood dust followed by metal dust. In this analysis the aluminum dust incident that happened in China was considered as a statistical outlier, however, was used in the qualitative analysis.

Through the literature review of the available incident and investigation reports, the research analysis was divided into two categories, ignition sources and contributing factors, that led to the explosion incident occurrence. Two ignition sources dominate significantly over others. Seven out of 20 analyzed incidents occurred due to friction, whereas six occurred due to self-heating/spontaneous ignition.

Based on the analysis of individual incidents the most frequent contributing factor to the incident that exacerbated the event was accumulated dust. The dust accumulated in the production areas due to the ineffective dust collection systems or underestimation of dust production volume. Accumulation of dust in the ductwork mainly was due to the insufficient airflow and absence of clean-out hatches that would allow employees to perform routine check-ups. The next contributing factor to the occurrence of the explosion incidents was design problems of the dust collection system. Design problems include, but not limited to dismissal of the dust fuel type, improper location of vents, absence of clean-out hatches, low airflow, detection system without sound alarm, delayed response of failure of detection/suppression system to respond on time, and failure to recalculate new design requirements based on the changes.

The detailed analysis was based on reliable sources such as investigation reports, scientific literature, and fire incidents reports obtained from Fire Marshals. Although these sources give comprehensive details of the events including personnel losses, they do not give financial loss information. few incidents have estimated financial losses available through the news outlets, however accurate. The collection of financial information for the specific incidents, that have been analyzed, were not successful. However, considering the extent of the damages to the production plants, it is possible to see which incidents and factors influenced the severity of the explosions.

**LEARN MORE: Download the final report [here](#)**

Research by:



LUND  
UNIVERSITY

Sponsored by:

