Seven Steps to Complete a DUST HAZARD ANALYSIS

By Chris Giusto

This article outlines the process of completing a dust hazard analysis (DHA) as required by National Fire Protection Association (NFPA) 652, Standard on the Fundamentals of Combustible Dust. The term *DHA* is often used interchangeably with the analysis portion of the processes (see Step 4), but a complete DHA process involves steps before and after the analysis.

It is critical to recognize that just completing the analysis does not make your facility any safer without appropriate follow-up actions (see steps 5 through 7). Another article, which will appear in the May 2020 issue of *PSJ*, explores these steps in greater detail.

The process outlined in this article assumes you have already determined that your facility manufactures, processes or otherwise handles combustible dust. If you are not sure, refer to the section "Is My Dust Combustible" of the author's blog "A Practical Guide to 5 Important Properties of Combustible Dusts" (Giusto, 2019c).

Step 1: Acquire Documentation

Begin by collecting any available relevant drawings and documents that define the process, equipment, operating parameters or existing hazards. Examples of this include:

- process flow diagrams (PFDs);
- piping and instrumentation diagrams;
- mass and energy balance;
- general arrangement drawings;
- building plans;
- equipment manufacturer drawings, data sheets, manuals, etc.;
- electrical hazard classification drawings.

Obtaining all these documents for existing facilities is often difficult. In such cases, field investigation is required to document the processes, equipment and facility to an adequate extent to facilitate the analysis. Plant operations staff can often be interviewed to obtain process data that is not documented.

Documenting and understanding the materials involved in the process and their properties at each stage are also required. Most processes involve changes to a material's properties such as size, particle size distribution and moisture content, which all have a significant effect on how hazardous the dust is. If the dust has been tested to determine properties [i.e., K_{st}, P_{max}, minimum explosive concentration (MEC)], copies of the test reports should be obtained and verified as representative of the various stages of any process where they might change.

The final set of documents required are the applicable NFPA standards. NFPA 652 provides guidance on the industry- or commodity-specific standards that may apply to your facility. Additional standards may also be applicable, but NFPA 68, Standard on Explosion Protection by Deflagration Venting, and NFPA 69, Standard on Explosion Prevention Systems, will likely be required references for any facility.

Step 2: Field Verify

Even when plant-specific documentation is available, it is frequently out of date or incomplete. The older the facility and existing documentation, the more likely there have been undocumented changes. Due diligence should be exercised to verify the information that will serve as the basis for the DHA.

In instances where existing documentation is limited, this step might be more appropriately titled "Field Survey." Extensive efforts may be required to sufficiently document larger, older facilities to support a thorough DHA. This is a great opportunity for facilities that lack up-to-date PFDs to revise their drawings to reflect the current state of the plant.

Step 3: Assemble DHA Team

NFPA 652 recommends (but does not require) that a DHA be completed by a team and requires that the DHA be led by a qualified person (Giusto, 2019a). Assuming you take a team approach, plant engineers, OSH personnel and plant management all bring different perspectives and are frequently involved in the DHA process. Be sure to consider including maintenance and operations personnel who often have hands-on experience that provides valuable insight about potential combustible dust hazards.

The perspective of a consultant who has been through the DHA process before can add tremendous value to your DHA. An outsider with experience in different facilities across a variety of industries might identify hazards and propose solutions your internal team members could overlook. To borrow a phrase, "You can't read the label from inside the jar."

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On Jan. 29, 2003, an explosion and fire destroyed the West Pharmaceutical Services plant in Kinston, NC, causing six deaths, dozens of injuries and hundreds of job losses. The CSB report found that the fuel for the explosion was a fine plastic powder, which accumulated above a suspended ceiling over a manufacturing area at the plant and ignited.

Step 4: Identify Hazards & Evaluate Compliance

This step is the heart of the DHA and the primary reason that the process is mandated by NFPA 652. Many combustible dust incidents have been a result of hazards that owners and operators did not even know existed. This step is the part of the process where you systematically review and think critically about your process and facility to identify the potential hazards.

There are different approaches and formats the team can use to facilitate this review, but the goal is the same: to consider every point in the process, identify hazards and determine what measures are required to minimize the risks. It is helpful to remember the flash-fire square (or quadrilateral) and explosion pentagon during this process (Giusto, 2019a). However, since air is usually the oxidizing agent, and you would not be conducting a DHA if you did not have combustible dust (fuel), the focus of the analysis tends to be on dust quantities or concentrations and ignition sources. For each step in the process and area of the facility, consider:

- Is there, or might there be, enough dust to produce a combustible atmosphere?

•Are there, or might there be, any means to disperse dust in a cloud?

•Are there, or might there be, any ignition sources?

It is also important to identify any protective measures that are already in place. If any hazards already have NFPA-compliant protection measures, no additional action is necessary. It is equally important to identify and document these measures in addition to the hazards. If measures are installed, they should also be evaluated to confirm compliance with NFPA standards.

For example, one facility the author worked with had an explosion vent on an indoor dust collector that was vented through the roof. Initially, this appeared to be a good strategy to safely vent an explosion. However, upon closer evaluation there was an improper weather cover over the vent duct, and the duct was not sized appropriately per NFPA 68. These issues created additional resistance that could have prevented the vent from functioning properly had there been an explosion. We determined that the roofline was too far away from the top of the dust collector to install a complaint vent duct, and a flame arresting vent with particulate retention was installed instead.

Step 5: Prioritize Hazards

Once the hazards are identified, the team must prioritize them so that the hazards presenting the greatest risk can be addressed first. As with Step 4, different approaches can be used but some sort of risk matrix is usually employed to rank the hazards based on the anticipated likelihood that the event could happen and its anticipated severity. Some hazards may require immediate action, while others can be scheduled to be addressed at a future time.

Step 6: Document Results

NFPA 652 requires that the results of the DHA be documented. Complete and thorough documentation is important for two primary reasons.

First, an authority having jurisdiction can request to see the DHA. This could be a local fire marshal, an OSHA representative or other safety official. Having a complete and well-organized report shows that you are compliant with the relevant codes and standards, or that you have identified any areas that need attention and have a plan to address them.

Second, the DHA report serves as a reference for management of change as processes are modified and your facility goes through upgrades or growth.

Step 7: Repeat

In facilities where combustible dust hazards have not previously been given adequate attention, completing a DHA will hopefully initiate a change in the organization from reactive compliance to proactive hazard management. The DHA needs to be revisited and updated as your facility undergoes changes. This includes changes to operating parameters of your existing processes, use of new or different materials or ingredients, installation of new equipment or processes. In some facilities, this could happen several times per year, while others may go long periods without significant changes. To help guard against complacency and the accumulative effects of unnoticeable changes, NFPA 652 Section 7.1.4 requires the DHA to be reviewed and updated at least every 5 years.

Conclusion

For plants with combustible dust, a DHA is essential to ensure the safety of the facility and personnel. This is why completing a DHA by Sept. 7, 2020, is required by NFPA 652. This information should help readers understand the steps required to complete a DHA and reinforce the value of the process beyond just compliance. **PSJ**

References

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