Combustible Dust
Hazards and Controls

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This presentation describes:
- Hazards of combustible dust
- Work practices
- Guidelines
- Training to protect employees
- OSHA’s National Emphasis Program
- Potential Citations

Dust Fire and Explosion: Georgia

CSB Identified Key Issues:
- Combustible Dust Hazard Recognition
- Minimizing Combustible Dust Accumulation
- Equipment Design and Maintenance

Dust Explosion Requirements

Adapted from CSB

Adapted from
“Combustible Dust in Industry:
Preventing and mitigating the effects of
fires and explosions”
OSHA Safety and Health Information Bulletin 07-31-2005
Acknowledgement – Ben Ross, OSHA Region IV

Deadly dust

Dust Fire & Explosion: Georgia
CSB Video on Imperial Sugar Explosion
Some event disturbs the settled dust into a cloud. Dust cloud is ignited and explodes.

**Facility Dust Hazard Assessment**

Combustible dust explosion hazard may exist in a variety of industries:
- food (e.g., candy, starch, flour, feed),
- plastics,
- wood,
- rubber,
- furniture,
- textiles,
- pesticides,
- pharmaceuticals,
- dyes,
- coal,
- metals (e.g., aluminum, chromium, iron, magnesium, and zinc), and
- fossil fuel power generation.

**Particles and Powders***

<table>
<thead>
<tr>
<th>Size</th>
<th>Diameter</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pellets</td>
<td>&gt; 2mm</td>
</tr>
<tr>
<td>Granules</td>
<td>0.42mm and 2mm</td>
</tr>
<tr>
<td>Dust particles</td>
<td>&lt; 0.42mm (420μm)</td>
</tr>
</tbody>
</table>

Hazard increases as particle size decreases:
- larger surface area for combustion
- Fine particle may have a larger role in dust cloud ignition and explosion propagation.

**Dust Combustibility**

Combustible dust per NFPA 654:
- Prior to 2006 - "Any finely divided solid material that is 420 microns or smaller in diameter (material passing a U.S. No. 40 Standard Sieve) and presents a fire or explosion hazard when dispersed and ignited in air."
- *2013 Edition - A finely divided combustible particulate solid that presents a flash fire hazard or explosion hazard when suspended in air or the process-specific oxidizing medium over a range of concentrations.

*25 watt light bulb probably cannot be seen through ten feet of a combustible dust mixture.*

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**What bulb?**

2 meters

40 g/m³ concentration of comb. dust suspended in air

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What is wrong here?
**Dust Combustibility**

Information sources (some better than others)
- "As used" test data
- Chemical supplier test data
- MSDS sheets
- Published tables

**Variables**
- Particle size,
- Shape
- Moisture content.
- Changes in the material produced by process equipment.
- Many others

**Electrical classification**

- **OSHA** Electrical standard (29 CFR Part 1910 Subpart S)
- **NFPA 70**, the National Electrical Code®.

**Other Hazard Analysis Considerations**

Some subjective (and not always accurate) rules of thumb

*Begin cleaning when dust reaches*
- When you can write in it
- When it obscures the color of the surface
- 1/64” inch thick
- 1/32” inch thick
- 1/16” inch thick
- 1/8” inch thick
- Really no need to clean if it hasn’t exploded by now, it won’t

**CPL 03-00-008 – National Emphasis Program**

"Immediate cleaning is warranted whenever a dust layer of 1/32-inch thickness accumulates over a surface area of at least 5% of the floor area of the facility or any given room. The 5% factor should not be used if the floor area exceeds 20,000 ft², in which case a 1,000 ft² layer of dust is the upper limit. Accumulations on overhead beams, joists, ducts, the tops of equipment, and other surfaces should be included when determining the dust coverage area. Even vertical surfaces should be included if the dust is adhering to them. Rough calculations show that the available surface area of bar joists is approximately 5% of the floor area and the equivalent surface area for steel beams can be as high as 10%.”

**Memorandum – April 21, 2015**

- Guidance for bulk densities less than 75 lb/cu.ft.
- 1/32 in. level assumes uniformity and bulk density of 75 lb/cu.ft.
- Layer Depth = (1/32)/(75)/Bulk Density
- Additional Criteria
- Over 1 inch accumulation - Can approximate Bulk Density

**Dust Control**

**NFPA 654** - contains comprehensive guidance

Some of its recommendations:
- Minimize the escape of dust from process equipment or ventilation systems;
- Use dust collection systems and filters;
- Utilize surfaces that minimize dust accumulation and facilitate cleaning;
**Ignition Control**

NFPA 654, identifies comprehensive guidance

- Use appropriate electrical equipment and wiring methods;
- Control static electricity, including bonding of equipment to ground;
- Control smoking, open flames, sparks;

**Dust Control**

NFPA 654 – guidance

- Provide access to all hidden areas to permit inspection;
- Inspect for dust residues in open and hidden areas, at regular intervals;
- Clean dust residues at regular intervals;

- Use cleaning methods that do not generate dust clouds, if ignition sources are present;
- Only use vacuum cleaners approved for dust collection;

**Ignition Control**

NFPA 654 - guidance

- Control mechanical sparks and friction;
- Use separator devices to remove foreign materials capable of igniting combustibles from process materials;
- Separate heated surfaces from dusts;

**Ignition Control**

- Separate heating systems from dusts;
- Proper use and type of industrial trucks;
- Proper use of cartridge activated tools; and
- Adequately maintain equipment.

**Ignition Control**

Other ignition sources

Use appropriate Class II Electrical equipment and wiring methods where required
OSHA 29 CFR 1910.178 (c) regulates powered industrial trucks in dust areas
Coal handling operations must comply with OSHA 29 CFR 1910.269
Employees need to be trained

- To recognize and prevent hazards associated with combustible dust
- In taking preventative action, and/or
- How to alert management.

They need to know

- The safe work practices applicable to their job tasks,
- The overall plant programs for dust control and ignition source control.

Training must be

- Before they start work
- Periodically to refresh their knowledge
- When reassigned
- When hazards or processes change

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Training

Management Responsibility

- Comply with the Hazard Communication Standard
- Have a qualified team conduct a facility analysis (or have one done by qualified outside persons) prior to the introduction of a hazard and
- Develop a prevention and protection scheme

NEP/ Industry Application

- Food products
- Agriculture
- Chemicals
- Textiles
- Forest and furniture products
- Metal processing
- Tire and rubber manufacturing plants
- Paper products
- Pharmaceuticals
- Wastewater treatment
- Recycling operations (metal, paper, and plastic)
- Coal dust in coal handling and processing facilities

Other Programs

- State plan participation in this national emphasis effort is strongly encouraged but is not required
- Does not replace the grain handling facility directive, OSHA Instruction CPL 02-01-004, Inspection of Grain Handling Facilities, 29 CFR 1910.272
- Not intended for inspections of explosives and pyrotechnics manufacturing facilities covered by the Process Safety Management (PSM) standard (1910.119)
- Does not exclude facilities that manufacture or handle other types of combustible dusts (such as ammonium perchlorate) covered under the PSM standard

CSHOs Safety and Health

- PPE and Nonspark Producing Clothing
- FR (Flame Retardant) coveralls
- Static-dissipative shoes / shoe covers
- Use of Cameras
- Use of Safe Practices when collecting dust samples
Primary Applicable OSHA Standards
- 1910.22 General – Housekeeping
- 1910.307 Hazardous (Classified) Locations
- 1910.178 Powered Industrial Trucks
- 1910.263 Bakery Equipment
- 1910.265 Sawmills
- 1910.272 Grain Handling
- General Duty Clause

NFPA Standards – Dust Hazards
- 61 Agriculture
- 68 Deflagration Venting Systems
- 69 Explosion Prevention Systems
- 70 National Electric Code
- 77 Static Electricity
- 85 Boiler and Combustion Systems
- 86 Ovens and Furnaces
- 91 Exhaust Systems

NFPA Standards Electrical & Systems
- 484 Combustible Metals
  - Includes Magnesium, Titanium, Zirconium, Aluminum, Tantalum and other reactive metals
- 499 Classification of Combustible Dust
- 65-4 manufacturing, Processing and Handling of Combustible Particulate Solids
- 655 Sulfur
- 664 Wood
- and more

Database of Combustible Dust
- BGIA GESTIS-DUST-EX Database of Combustion and Explosion Characteristics of Dusts
  - Important characteristics of more than 4000 dust samples from virtually all sectors of industry
  - Developed in Germany with the financial support of the EC

Database of Combustible Dust
- There are limits of applicability of the data
  - a wide variation is possible in the nature of the dusts
    - e.g., composition, particle size distribution, surface structure, moisture content, etc.
  - the numerical value of the characteristics depend on the test methods
- Always be aware that the values listed only serve as a guideline for the design of preventive and protective measures.
- http://www.hvbg.de/e/bia/gestis/expl/index.html

Citations
- Employer Knowledge
  - NFPA is one source
  - Industry seminars and publications
- Prior explosions & fires
  - In the news
  - In the employer’s facility
Citations

- Typical hazards
  - Accumulation of combustible dust in areas which have/may have ignition sources
  - Lack of, or inadequate, explosion mitigation
  - Failure to control ignition sources inside equipment
  - Cleaning dust with non-explosion proof equipment (e.g., vacuums)

Citations

- Typical hazards (con't)
  - Cleaning dust with compressed air (electrostatic issue)
  - PPE
  - Inadequate Ventilation
  - HazCom training

Citations

- Where possible, use OSHA/State OSHA standards
- Combustible Dust Rule in Pre Rule Stage as of Spring 2015 Agenda
- Other Standards
  - 1910.22(a)(1) - General Housekeeping
  - 1910.176(c) - Housekeeping in storage areas
  - 1910.307 (See Class II Locations)
    - Class III and Class I Locations may be an issue, too
  - 1910.269(v)(11)(xii) – Electrical Power Generation
    - State specific standards

Citations

- 5(a)(1)
  - See the Sample Citations File
  - NFPA standards are used as both
    - Evidence of industry recognition
    - Feasible and Acceptable Abate method
  - Reference Mandatory “shall”s” in NFPA to ensure standard requirements
  - Use “shoulds” for abatement recommendations

Citations

- Other important standards
  - 1910.1200 – HazCom
    - Failure to train
    - Inadequate MSDS
    - Also a possible source of employer knowledge
  - 1910.132(a)
    - Properly assess workplace hazards & provide
    - Non-static clothing
    - Flame retardant clothing
    - Footwear

Citations

- Other important standards
  - 1910.119
    - When dust is listed in Appendix A, 1910.119 can be cited in its entirety
    - Possible citations if dust explosion hazard not evaluated in Process Hazard Analysis and could affect covered processes
      - May lead to additional citations such as:
        » Siting
        » Training
        » Operating procedures, etc.
Citations

- Other important standards
  - 1910.178 (Powered Industrial Trucks)
  - 1910.252 (Welding, Cutting and Brazing)
  - 1910.145(c)(3) – Warning signs
  - 1910.156 (or 1910.38)
  - 1910.263(k)(2) – Bakery Equipment
  - 1910.265(c)(20)(i) – Sawmills
  - Agriculture
    - HazCom
    - General Duty