Dust Hazards

Gregory F. Creswell, CSP, SGE
Regional Safety Manager
DUST HAZARDS

- Dust in the industry is not quite like the kind that may collect at home. In an industrial setting, dust can contain toxic substances and/or become a fire hazard.
- It could come from sources such as blending, sawing, cutting or other operations that change the shape of the material being processed.
- Material handling by conveyors, mobile equipment operations
• What are the factors influencing the effects of dust?

➢ One main factor is the size of the particles.
  – Larger particles will rapidly settle.
  – Smaller particles may be dispersed in the air for as long as 8 hours.
Possible ways to prevent fires caused by dust particles.

- Good housekeeping.
- Use of vacuums instead of brooms.
- Efficient storage and transport.
- Use of wet processes.
- Enclosure of dust-producing processes under negative air pressure (slight vacuum compared to the air pressure outside the enclosure).
- Exhausting air containing dust through a collection system before emission to the atmosphere.
- Controlled disposal of dangerous waste.
Explosive Dust

Any combustible material (and some materials normally considered noncombustible) can burn rapidly when in a finely divided form. Combustible dusts are fine particles that present an explosion hazard when suspended in air in certain conditions. A dust explosion can be catastrophic and cause employee deaths, injuries, and destruction of entire buildings.
Required Conditions for an Explosion

- The dust must be combustible and fine enough to be airborne.
- The dust cloud must beat the Minimum Explosive Concentration (MEC) for that particular dust.
- There must be sufficient oxygen in the atmosphere to support and sustain combustion.
- There must be a source of ignition.
- The dust must be confined.
- The dust must be dry.

Dust Particle
Fire Prevention and Control

Policies, practices and procedures designed to keep the conditions necessary for a fire from coming together (explosive pentagon)

- Fuel (dust)
  - Dust is dry
  - Dust is at MEC
- Oxygen
- Ignition source
- Confined or enclosed space
- Mixing of fuel and oxygen

**Explosive Pentagon**
Fire Prevention and Control

- Housekeeping
  - Building beams
  - Slope surfaces
  - Top of equipment
  - Corners
- Hot work permits
- Control of Hazardous Energy
- Design specifications for storage of flammable materials
- Severity reduction policies, practices and procedures designed to minimize the spread of fire
  - Housekeeping
  - Grounding/Bonding
- Emergency plans
  - Know what to do and where to go
- Alarm systems
Dust explosion in a work area

Some event disturbs the settled dust into a cloud

Dust settles on flat surfaces

Dust cloud is ignited and explodes

Adapted from CSB
TIMELINE

The following nine slides depict a timeline for a dust explosion and the results of that explosion.

Slides prepared by Joseph P. Howicz CSP, CFPS
Accident Prevention Corporation
W.W.W. safetyman.com
A Dust Explosion Event

Primary deflagration inside process equipment

Time, msec.
(Timing of actual events may vary)
A Dust Explosion Event

Shock wave caused by primary deflagration

Time, msec.

Gregory F. Creswell, CSP, SGE, Regional Safety Manager, TIMET

October 7-10, 2012 • Atlanta, Georgia, USA
A Dust Explosion Event

Shock waves reflected by surfaces within the building cause accumulated dust to go into suspension.
Dust clouds thrown in the air by the shock waves
A Dust Explosion Event

Primary deflagration breaks out of the equipment enclosure - creating a source of ignition

Gregory F. Creswell, CSP, SGE, Regional Safety Manager, TIMET
October 7-10, 2012 • Atlanta, Georgia, USA
A Dust Explosion Event

Secondary deflagration ignited

Time, msec.

0 25 50 75 100 125 150 175 200 225 250 300 325

Gregory F. Creswell, CSP, SGE, Regional Safety Manager, TIMET

October 7-10, 2012 • Atlanta, Georgia, USA
A Dust Explosion Event

Secondary Deflagration is propagated through the dust clouds

Time, msec.

Gregory F. Creswell, CSP, SGE, Regional Safety Manager, TIMET

October 7-10, 2012 • Atlanta, Georgia, USA
Secondary deflagration bursts from the building

Time, msec.

Gregory F. Creswell, CSP, SGE, Regional Safety Manager, TIMET

October 7-10, 2012 • Atlanta, Georgia, USA
A Dust Explosion Event

Collapsed building with remaining fires

Time, msec.

Gregory F. Creswell, CSP, SGE, Regional Safety Manager, TIMET

October 7-10, 2012 • Atlanta, Georgia, USA
NFPA 484 Standard for Combustible Metals

• Chapter 4
  – Determination of the combustibility or explosibility of a metal, metal powder, or metal dust.
    • Determination of combustibility
      – No reaction
      – Glowing but no propagation along powder train
      – Propagation along powder train past the heated zone
    • Test method
      – Apply 1000 degree torch for 10 minutes
      – Material ignites and propagates combustion, or ejects sparks after heat is removed the material shall be considered combustible.
      – If combustible NFPA 484 Standard applies.
NFPA 484 Standard for Combustible Metals

- Determination of explosibility
  - Minimum ignition energy (MIE)
  - $K_{st}$ value
  - Minimum explosible concentration (MEC) (g/m$^3$)
  - Test method ASTM E 1226 Standard test method for explosibility of dust clouds
NFPA 484 Standard for Combustible Metals

- Risk evaluation
  - Process Hazard Analysis (PHA)
  - Failure Mode Effect Analysis (FMEA)
- Performance based design option
  - Design objectives
    - Life safety
    - Fire scenarios
      - Fuel
    - Explosion scenarios
      - Material storage or conveyance
Questions?