Combustible Dust Environment in 2014

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Combustible Dust Environment in 2014

The Challenge in the past:

• Maintain Plant and Worker Safety under increasing scrutiny and awareness of combustible dust hazards in industry.
Today

• The Rules of today and the near future.
• The “Hazards” review
• Clean-up Equipment
• Final Strategy
Who’s In Charge?

Authority Having Jurisdiction (AHJ)(NFPA)

“An organization, office, or individual responsible for enforcing the requirements of a code or standard, or for approving equipment, materials, an installation, or a procedure”

NFPA 654.3.2.2 (2013)

Provincial Occupational Health and Safety
Local Fire Department / Fire Marshall
Provincial Fire Commissioner
Your Insurance Carrier
NFPA 654 (2013): Prevention of Fire and Dust Explosions in Manufacturing, Processing and Handling of Combustible Particulate Solids

NFPA 61 (2013): Prevention of Fires & Dust Explosions in Agricultural & Food Processing Facilities

NFPA 68: Explosion Venting Systems

NFPA 69: Explosion Suppression Systems

NFPA 91: Pneumatic Conveying Systems

NFPA 77: Recommended Practice on Static Electricity

About the NFPA

• Standards, Codes, Recommended Practices and Guides
• Retroactive: NO Grandfather Clauses
• NO authority to police or enforce compliance
• Non-Profit, Developed by Volunteers
• They evolve...and sometimes disagree
What is a Combustible Dust?

Then...
NFPA 654-2006 and 484-2009: “Any finely divided metal, xxx microns (xx mesh) or smaller”

Now...
NFPA 654-2013 and 484-2012, 3.3.5: “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.”

New: 500 micron/20mesh, Dust, fines (<45), superfines (<10), ultrafines (<1), flakes, paste and ribbon

Combustible or (Flash-Fire) Flammable?

Combustible Particulate Solid (NFPA 654.A.3.3.6): Assume particle reduction
Combustible or Flammable?

**Diagram:**
- Dispersion of Dust
- Confinement of Dust
- Ignition Source
- Oxygen
- Combustible Dust/Fume

**Triangle:**
- Oxygen
- Heat
- Fuel
Deflagration - Explosion - Flash Fire

- **Deflagration:** “...propagation of a combustion zone (flame front or pressure increase) at a velocity that is less than the speed of sound in the unreacted medium” NFPA 654.3.3.8 (2013)

- **Explosion:** “The bursting or rupture of an enclosure or container due to the development of internal pressure from a deflagration’.” NFPA 654.3.3.14 (2013)

- **Flash Fire:** “A mixture of a flammable gas at greater than 10% of its lower flammable limit with either a combustible dust or a combustible mist” NFPA 654.A.3.3.15 (2013)

(Both hydrocarbon and dust flash fires generate temperatures from 1000 – 1900 degrees F.)
Primary & Secondary Explosions

Primary Explosion

Secondary Explosion

Blast Wave

Dust cloud formed

Dust Accumulation

Heat from primary explosion ignites dust cloud
How do I know that my dust is combustible?

- Testing through third-party companies
- MSDS Sheets
What will testing cost and what kind of information will I receive?

- “Go, No-Go” “You can’t be a little-bit combustible” (approximately $1000-$1500)

- “Go” → Further testing for Kst, Pmax, Minimum Ignition Temperature (MIT), Minimum Ignition Energy (MIE) (approximately $1500-$200)

- Kst and Pmax

- 20-liter vs. 1 m³ test sphere results
Electrical Classification and Sources of Ignition

- CEC Area Classifications: Class / Division / Group
- CE / ATEX Classifications: Areas / Zones
- Improper electrical equipment
- Avoiding Ignition Sources (static electricity, heat, friction, impact, bearing/machinery failure, flash fires gas ignition)
- Vacuum Systems and Dust Collector internals are “CLASSIFIED AREAS” due to dust confinement
What is Housekeeping: Vacuum Cleaning vs. Dust Collection

Dust Collection:

- Ambient or source-capture air cleaning (airborne dusts)
- High Airflow: thousands of CFM or more
- Low Vacuum (5”–20” Waterlift / 0.5”- 1.5” Hg)
- Hose/duct sizes: 3” and larger (75mm and up)
What is Housekeeping: Vacuum Cleaning vs. Dust Collection

**Vacuum Cleaning:**

- “Dusts that have settled on horizontal or vertical surfaces”
- Low Airflow (100CFM to 1-2 thousand CFM)
- High Vacuum (100” – 220” Waterlift / 8”-16” Hg)
- Hose sizes: 1.5” to 4” (38mm – 100mm)
Housekeeping / Cleaning Frequency

NEW to NFPA 654-2013

• Don’t exceed the dust threshold, such as layer-depth criterion @ 1/32” or as adjusted by NFPA formulae (654.8.2.1 et al)

• Regularly scheduled inspection by owner

• Time studies and allowances for cleaning certain conditions made known to workers to maintain compliance
Cleaning Methods
NEW to NFPA 654-2013

• “Vacuuming shall be the preferred method of cleaning”. (NFPA 654.8.2.2.2 et al)
• “Where vacuuming is impractical, permitted cleaning methods shall include sweeping and water wash-down”
• “Blow-downs using compressed air (30 psi max) or steam shall be permitted to be used for cleaning inaccessible surfaces or surfaces where other methods of cleaning result in greater personal risk” (Electricals must be NEMA 12 minimum, all ignition sources or hot surfaces are shut-down, removed or isolated)
Types of Industrial Vacuum Cleaning Systems

Portable
Stationary
Semi-Portable
Transportable
Submerged Recovery
Source Capture
Portable Vacuums

• Carried or pushed

• Backpack, hand-carried, roll-around

• Compressed-Air-Powered and electric

• Advantages: Lower cost, fast intervention, ready access and convenient utilities
Portable Vacuums
Semi-Portable Vacuums

- **Moveable by one person or forklift**

- **Hybrid of convenience of a central vac with power and flexibility of portable vac**

- **Local tubing / piping networks**

- **Benefit from indoor “location”**

- **Less than 8 ft³ “dirty” volume**
Stationary Vacuum Systems

- Vacuum Producer
- Filter Separator Unit
- Collection Container
- Tubing or Piping Network
- Controls
- Prevention, Protection, Isolation,
- Deflagration Venting
- Chemical Suppression
More Change

NFPA 654 (2013):

- “The second change (to 654-2013) is to establish a hierarchy for cleaning methods: **vacuuming first**, followed by sweeping or water wash…” (pg 654-2)
- “Air-material separators with a dirty-side volume of 8ft³ or greater shall be located **outside** of buildings (654.7.13.1.1.1)
- Where an explosion hazard exists, isolation devices are required unless the connecting **ductwork is less than 4”** nominal diameter. (654.7.1.6.2(2))
- Central vac design:
  “No more than two simultaneous hose connection stations should be allowed on any one line to the AMS (654A.7.3.2.7), Hose lengths should be 25ft or less (654A.7.3.2.7.2). Central vacs should not be a dust storage device (654A.7.3.2.7.4),
- **Line-clearing function upon shut-down, isolation devices, access doors grounded/bonded**

Central Vac Design Data:
...

“Operating and maintenance procedures shall address PPE including flame-resistant garments”. Annual emergency plan review....annual training certification.
Stationary Vacuum Systems

Outdoor Installation with Deflagration Vent

Indoor Installation with Flameless Venting
Stationary Vacuum Systems

Deflagration Vent Duct
Stationary Vacuum Systems

Mechanical Isolation Valves

Photo courtesy of Dow Chemical (Fenwal)

Chemical Suppression*

Photo courtesy of Dow Chemical (Fenwal)
Submerged Recovery - Portable

• Renders explosive materials inert
• Draws materials through a liquid bath
• Match the liquid to the powder
• It is rocket science
Submerged Recovery - Central

Vacuum Line

Wall

Vacuum Pump Package

Flexible Hose Connection to Vacuum Line

Sanitary Tri-Clover Inlet Connection

Static Conductive Suction Hose

Customer’s Equipment

Submerged Recovery Intercept and Cart:
Continuously Welded Anti-Sparking Stainless Steel with Grounding Reel, High and Low Level Liquid Cut-Off, And Static Conductive Casters

Not To Scale

AirSys Tech Inc.
Applications in a Grain-Handling Facility

- Floor Cleaning
- Wall Cleaning
- Top of Machinery
- Overhead Cleaning (cable trays, pipework, I-beam flanges, joists, perlens)
- Reclaiming of material for recycle
Reclaim & Recycle
Outside Contractors

- **YOU are “responsible” to know their qualifications.**
- **They are operating an ad hoc central vacuum system in your facility**
- **Is their equipment in good operating condition?**
- **YOU are “responsible” to monitor their work**
- **Disposal Issues: Cradle-to-Grave**
So...What Do I Do Now?

- **Don’t sweep the issue under the rug!**
- **Be proactive:**
  - **Anticipate** an inspection
  - **Anticipate** change
- **Remove the shop-type vacuums**
- **Get your dust tested**
- **Get your paperwork in order**
  - MSDS
  - **Emergency Response Plans**
  - **Employee Training Manuals**
  - **Material Combustibility Test Reports**
...and then...

- *When you know everything about your dust(s), you have appropriate industrial vacs, and your employees are on-board...*

  - *Start Cleaning!* **
A Clean Plant: It’s Good Business

- **Employee Health and Safety**
- **Lower operating costs:**
  - increased equipment “uptime”
- **Continuing operations**
- **Improved product quality**
- **Recycling or reclaiming lost products**
- **Lower workmen’s compensation costs**
Links

• *AirSys Tech Inc.*
  [www.airsystech.ca](http://www.airsystech.ca)

• *VAC-U-MAX*
  [www.vac-u-max.com](http://www.vac-u-max.com)

• *NFPA*
  [www.nfpa.org](http://www.nfpa.org)