Considerations for Processing Materials with Dust Explosion Hazards in a Granulation Process

Company: Stellar Manufacturing Co.
Presenter: Wiley Bradford
About Stellar Manufacturing

• Stellar Manufacturing Co. is a contract manufacturing company that specializes in processing dry chemicals.
• Stellar has over 25 years of experience in contract manufacturing.
• Stellar offers integrated manufacturing processes to make your materials marketable - from powder to product.
From Powder to Product

MATERIAL PROCESSING
- Compaction
- Granulation
- Blending & Mixing
- Compaction Briquetting
- Tableting

PACKAGING & SUPPLY MANAGEMENT
- Filling
- Industrial Packaging
- Consumer Packaging
- Warehousing
Don’t Ignore Dust Explosion Hazards!

– *Imperial Sugar Dust Fire and Explosion:*
  
  • Georgia (14 killed, dozens injured) February 2008
What are the 3 Requirements for a Fire to Occur?
What are 2 Additional Requirements for Dust Explosion to Occur?
What is Combustible Dust?

– Dry powder that presents a fire or explosion hazard when suspended in air
– Either organic or metal dusts that are finely ground into very small particles
Identify If Material Presents Hazard

• SDS
  – Hazards
  – Storage and Handling
  – Physical Properties

• Material Testing Information
  – Severity of Explosion
  – Ease of Ignition
  – Concentrations
Kst Value

• The dust deflagration index, measures the relative explosion severity compared to other dusts. The larger the value for Kst, the more severe the explosion.

<table>
<thead>
<tr>
<th>Dust explosion class*</th>
<th>$K_{st}$ (bar.m/s)*</th>
<th>Characteristic*</th>
<th>Typical material**</th>
</tr>
</thead>
<tbody>
<tr>
<td>St 0</td>
<td>0</td>
<td>No explosion</td>
<td>Silica</td>
</tr>
<tr>
<td>St 1</td>
<td>&gt;0 and ≤ 200</td>
<td>Weak explosion</td>
<td>Powdered milk, charcoal, sulfur, sugar and zinc</td>
</tr>
<tr>
<td>St 2</td>
<td>&gt;200 and ≤ 300</td>
<td>Strong explosion</td>
<td>Cellulose, wood flour, and poly methyl acrylate</td>
</tr>
<tr>
<td>St 3</td>
<td>&gt;300</td>
<td>Very strong explosion</td>
<td>Anthraquinone, aluminum, and magnesium</td>
</tr>
</tbody>
</table>

The actual class is sample specific and will depend on varying characteristics of the material such as particle size or moisture.

* OSHA CPL 03-00-008 - Combustible Dust National Emphasis Program.
** NFPA 68, Standard on Explosion Prevention by Deflagration Venting.
Minimum Ignition Energy (MIE)

• The minimum ignition energy, which predicts the ease and likelihood of ignition of a dispersed dust cloud.

• Materials that ignite above 0.50 joules are not considered sensitive to ignition by electrostatic discharge.
  – Min. Ignition Temp. of a Cloud < 400° C
  – Min. Ignition Temp. of a Layer 5mm < 300° C
  – Min. Ignition Energy of a Cloud < 15 mJ

Source: Combustible Dusts, Bruce L. Rotter, AIHce 2006, Chicago, IL
Minimum Explosible Concentration (MEC)

• The minimum explosible concentration, which measures the minimum amount of dust dispersed in air required to spread an explosion.
Factors Impacting A Powder’s Explosibility

• Moisture content
  – Below 5% is considered “dry”
  – Surface moisture of particle can impact electrical conductivity

• Particle Size
  – Ignition sensitivity and explosibility increases as particle size decreases

• Particle Shape

• Operating Temperature

• Operating Pressure

• Concentration
Explosion Protection Strategies

• Detection and Removal of Oxygen
  – Inert Gas (CO2, Nitrogen)

• Containment of Explosion
  – Control Propagation

• Venting
  – Explosion Door
Eliminate Sources of Ignition

• Static Electricity
  – Properly grounded equipment and personal

• Heat from bearing or motor
  – Temperature Sensors, Alignment Sensors

• Tramp Metal Spark
  – Magnets

• Electrical Spark
  – Properly sealed wiring, special plugs

• Forklift
  – Appropriately rated forklift
Eliminate Sources of Fuel & Oxygen

• Buildup of Dust on Equipment
• Purging Equipment with an Inert Gas
Case Study

• Compaction and Granulation System
OSHA & NFPA Standards May Apply

Equipment Specific

• Dust Collector
  – Explosion Venting, Ductwork Isolation Valve, and Grounding
• Bucket Elevators
  – Belt Alignment, Speed, and Bearing Temperature Sensors, Explosion Venting
• Milling
  – Rare Earth Magnets
Overall Process

• Electrical
  – Motors, Electrical Wiring, and Sensors (Class 2 Div2)

• Personnel
  – Training, Grounding, Forklift, Vacuums

• Structure/Building/Walls
  – Fire Rating, Dust Accumulations

• Procedures
  – MOC
Compaction System
Summary
Thank you!
Questions?