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Sandia National Laboratories

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DUST HAZARDS ANALYSIS

Sandia History and Path Forward

Tomas M. Sanchez, PE – Sandia NM Fire Marshal

DOE EFCOG – Fire Protection Workshop

Golden CO

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TOPICS

A. History w/Combustible Dust

B. DHA Approach

C. Lessons Learned

SANDIA HISTORY WITH COMBUSTIBLE METAL DUSTS

Image – Sandia news release, October 11, 2016

Explosives

Research and development

Storage

Explosive Safety purview

Fire Protection – Limited Involvement

Image – Thermal Spray Research at Sandia

Spray Coatings

Research and development

Thermal/Plasma

Long history at Sandia

Wire/Powder feed stocks

Dust collection

Image – Tomas Sanchez (3D printer @Sandia CA)

Additive Manufacturing

Variety of powders

Combustible vs noncombustible

Occupancy type

Controls

SANDIA HISTORY WITH COMBUSTIBLE METAL DUSTS

A. Combustible Dust Operations
   1. Sandia has had these operations for decades
   2. Sandia researcher brought forward safety requirements in 2013/2014
      a. NFPA 484

B. Sandia Fire Protection approach
   1. New process – LIMIT to 5 lbs operations / 50 lbs storage
   2. Existing – imposed limits when possible; safety documentation
   3. Upgrade facilities

SANDIA HISTORY WITH COMBUSTIBLE METAL DUSTS

C. Limiting operations worked for awhile…

1. Proof of concepts – successful, and moving on to production
2. Increase in quantities – case by case basis

D. Challenges

1. Lack of High Hazard Group 2 or 3 space
2. Quick turn arounds
3. Dust testing and hazards analysis
4. Technical challenges

DUST HAZARD ANALYSIS - APPROACH

*Images from NFPA.org

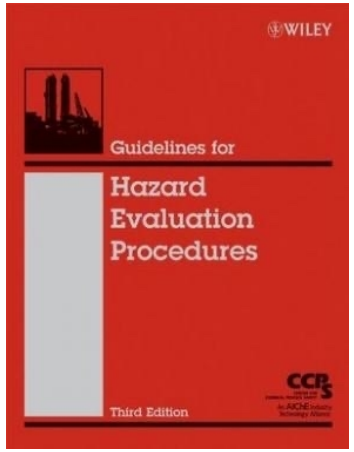


Image from AIChE

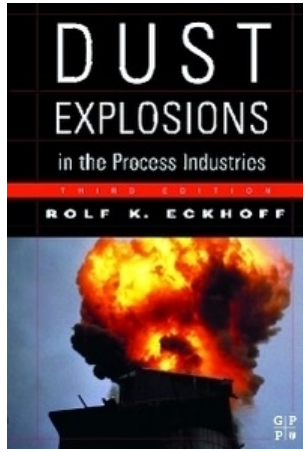


Image from Elsevier

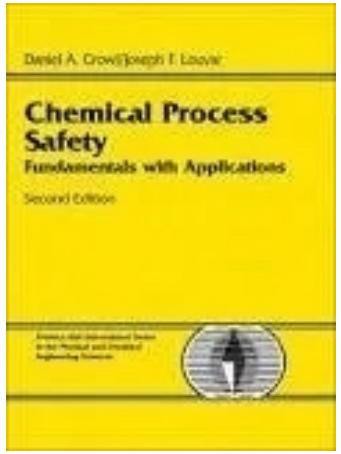
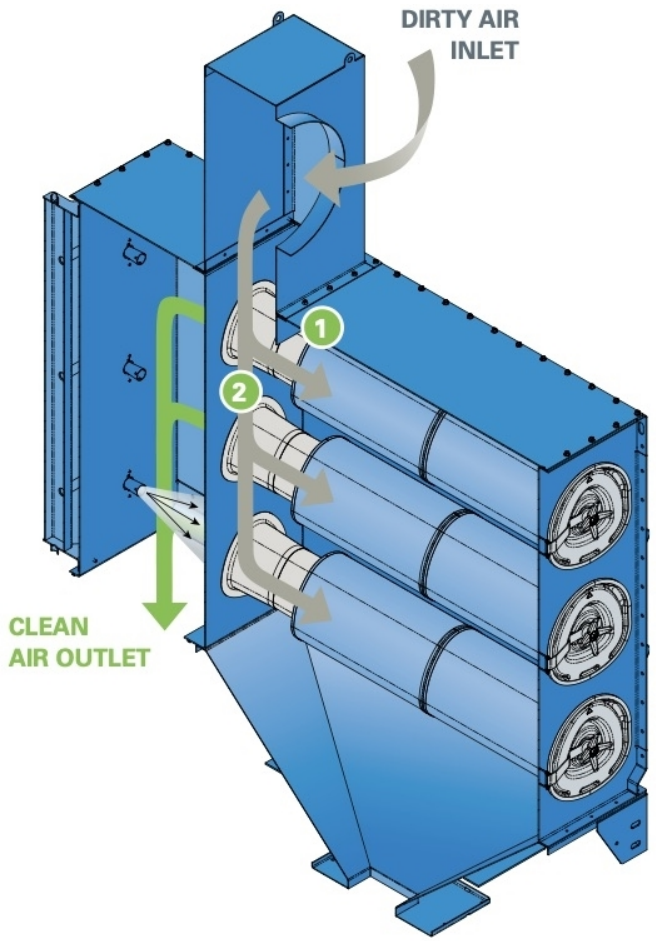


Image from Abebooks

A. Address requirements in NFPA Standards
   1. Example Hazards Analysis – Appendix
B. SFPE Dust Explosion Webinar
   1. John Cholin – Instructor
   2. Outlines the process
      a. Point-to-point movement of the dust
   3. What-If?
   4. References/subject matter experts
   5. Derive controls

DUST HAZARD ANALYSIS - APPROACH



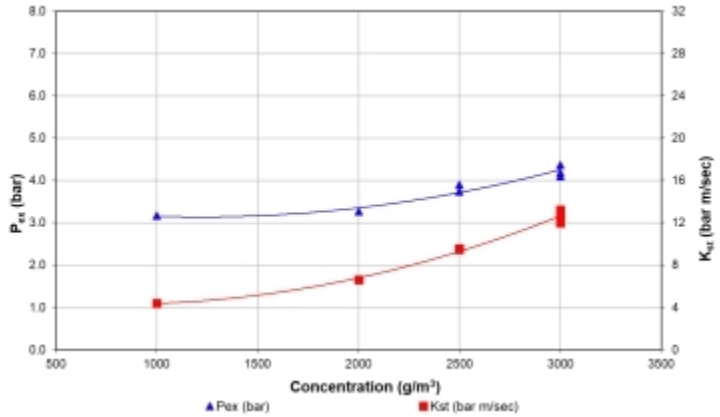
No.	What-If	Disposition
D 1	What if a credible ignition source is introduced into the dust collector during normal operations?	Low risk event. During normal operations, the dust collector will have an LOC of 2%.
D 2	What if a credible ignition source is introduced to the dust collector during routine maintenance, cleaning, or troubleshooting?	Possible flash fire and deflagration hazard. Evaluate further.
D 3	What if the filters fail allowing combustible dust to contact dust collector fan?	Possible flash fire and deflagration hazard. Evaluate further. Essentially the same scenario as question 2.
D 4.	What if a hot sparks/ember from the plasma spray reach the filters or the dust collector drum?	Possible flash fire and deflagration hazard. Evaluate further.
D 5	What if the plasma spray torch is operated at a higher-than-expected power?	Possible flash fire and deflagration hazard. Evaluate further.
D 6	What if the dust collector is operated at a temperature greater than its designed operating limit (i.e., 150°F)?	Possible flash fire and deflagration hazard. Evaluate further.

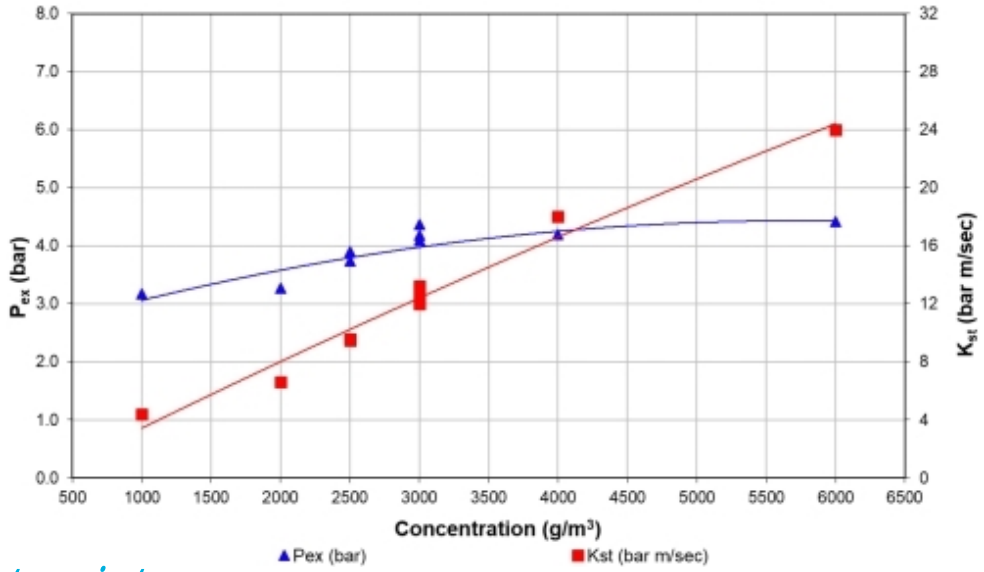
LESSONS LEARNED

A. Not recognizing the hazards

1. Customers did not understand the material could be a hazard
   a. Safety Data Sheet identified hazard
   b. Although common material, identifying the material was not allowed to be disclosed to A/E
   c. A/E partners asked hard questions later and got us back on track

B. Test results not conservative



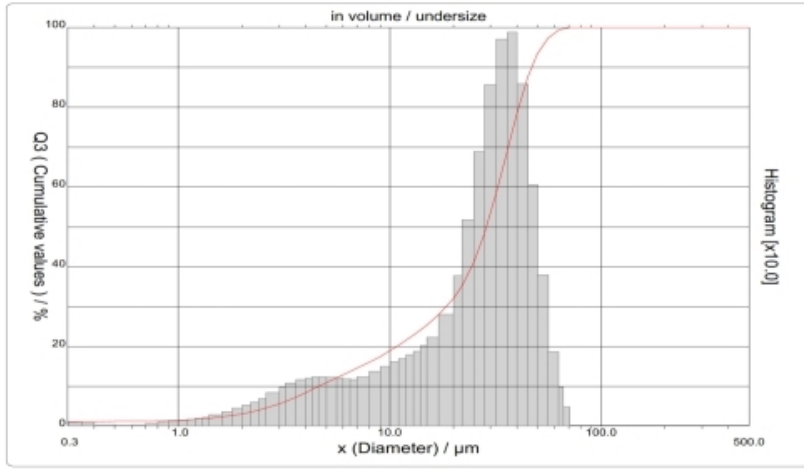


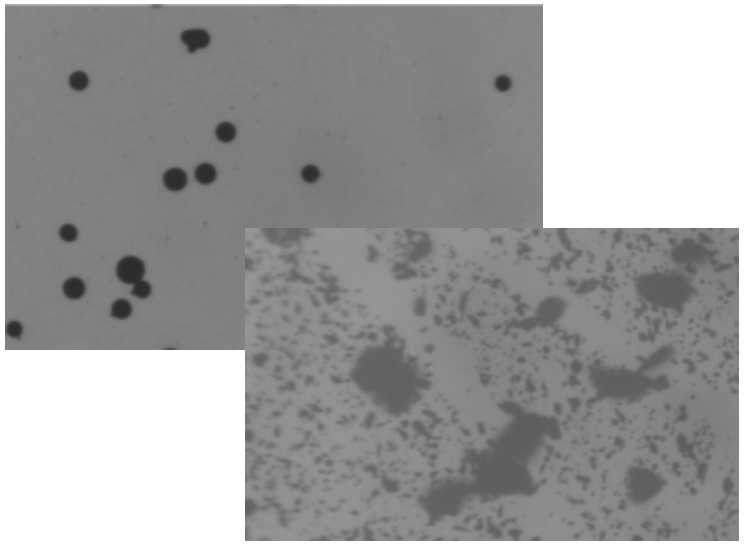
Request more test points

LESSONS LEARNED

C. Incomplete Results
   1. Example – single over pressure result reported
   2. K_{ST}, , Minimum Ignition Energy, Auto Ignition Temp

D. Off normal conditions
   1. Product quality requires inert environment (< 2% LOC)
   2. Troubleshooting activities – no inert environment





E. Material Availability / Testing Lead Times – start early

F. Cost of testing is becoming an issue
   1. Internal tracking of all tested material
   2. Caution - morphology / powder size

QUESTIONS