Housekeeping Solutions: Strategies and Tools

Mark Holcomb, MS, CIH, CSP

Technical Leader – Global OS&H

Personal Care

Diapers, Training/Youth/Swim Pants, Feminine Care, Incontinence Care, Infant and Child Wipes and Toiletries

Consumer Tissue

Facial Tissue, Bathroom Tissue, Paper Towels

K-C Professional and Other

Disposable Health & Hygiene Products for Away-From-Home Use: Facial Tissue, Bathroom Tissue, Paper Towels, Wipers, Protective/Absorbent Products for Do-It-Yourself Use; Nonwovens

Health Care

Surgical Drapes and Gowns, Sterilization Wrap, Face Masks, Exam and Surgical Gloves, Respiratory Products

K-C's Businesses

- Nearly 55,000 employees worldwide
- Manufacturing Facilities in 36 countries
- Sales in over 150 countries

K-C's Brands

Kimberly-Clark provides some of the world's most recognized consumer brands in more than 80 countries

Nearly 1.3 billion people purchased K-C's quality products last year!

A Combustible Dust Journey

- Practical tips for establishing a sustainable combustible dust compliance process.
- Help you avoid the “PDCA” approach (plan-do-complicate-abandon)

A Brief “CD” History

- General Awareness of the hazards, especially in the air systems engineering group.
- Tested dust collector materials.
- Relied heavily on spark suppression in dust collectors.
- Never experienced a secondary explosion.
- Had experienced deflagrations in duct work of wet dust collection systems.
- Small fires in overheads and in equipment.

Combustible Dust before OSHA

- K-C established guidelines for housekeeping in tissue manufacturing in the late 1980's, based on testing of fugitive dust by FM.
- Relied heavily on spark suppression to protect dust collection systems.
- Primary risk was fires, although infrequent occurrences in overheads were not severe.
- Established fugitive dust level requirements based on depth - ¼ - ½ inch.
- Relied on compressed air as primary "cleaning" method.
- NEMA 12 (dust tight) electrical required for upgrades and new plants. Did not retrofit older plants.

OSHA Inspection

- Began in September, 2005.
- Initiated by an employee complaint.
- Same time frame as CSB Combustible Dust study.

Plant Description

- Build in 1952
- Tissue Manufacturing and converting in separate areas of the plant.
- Both general and local ventilation system:
  - Local ventilation collects 99%+ of generated dust.
  - Sprinkler protection in building and dust collection systems
  - Spark Suppression and Explosion venting
- House Keeping:
  - Relied on Compressed Air because of access issues when process is running.
  - Following FM 7-76 equation to trigger overhead cleaning (¼ – ½ inch average depth).

Converting Area

Ventilation System and Overhead Areas

Citations

- OSHA issued one serious citation, two parts:
  - Electrical equipment not approved for class II, division 2 - 29 CFR 1910.307 (b) (2) (i)
  - House Keeping – excessive dust accumulations in overheads - 29CFR 1910.22(a)(1)
  - $9,000 penalty.

Key Questions

- **How much dust is too much?**
- **How to clean the overheads?**

Bulk Dust Testing Results

- Density: < 2.5 lbs per cubic foot.
- Particle Size Distribution: 90% passed 40 mesh (425 um) sieve.
- Moisture Content: ~5%
- Minimum Explosive Concentration (MEC): 75 - 100 g/m^3, dried and sieved
- K_{st}: 136 bar-m/s dried and sieved; 54 bar-m/s as is.

NFPA 654 and FM 7-76 Depth Approach

- Based on Dust Density
  - No standard method for determining dust density, as it accumulates on surfaces
- Results: 0.5 – 4.5 inch depth.
- Non-uniform accumulations and high overhead area make accurate measurement of dust depth challenging.
- Depth of dust does not predict the hazard – the mass of dust predicts the hazard.

Alternative Dust Threshold Equation

- $M_{dmax} = (0.031 * C_{opt} * V_{room})/A_{dust}$

- C_{opt} - Concentration that produces highest pressure rise
- V_{room} – Room volume
- A_{dust} – Dust accumulation surface area
- **Results:**
  - 233 g/m^2 average loading.
  - Apply 50% safety factor (missed cleaning):
  - = 116 g/m^2

Dust Accumulation Rate

- Determine average based on 6 representative sample points.
- Perform monthly sampling for 6 months to determine average accumulation rates

Dust Collection and Testing

- Collected dust in pre-weighted metal 1 gallon paint cans.
- Battery operated vacuum with cyclonic dust system used for curved surfaces
- Dried, posted weighed by 3rd party laboratory

What We Learned

- New consensus standard requirements are for the most part retroactive.
- Existing standards do not address low density materials.
- Electrical safety requirements and house keeping are closely linked.
- Vacuum cleaning can introduce new hazards associated with working at heights.
- Engineering solutions aimed at eliminating fugitive dust accumulations in over-head structures are more cost effective.
- Dust thresholds based on mass instead of depth are much easier to apply.

Implementing a Combustible Dust Compliance Program

Leadership Endorsement

Concerns:

- Leaders questioned if there was a real risk or if this was only a compliance issue.
- Unknown cost impact.
- High plant & staff work loads.
- Gap closure timeline.

Response:

- Used the Chemical Safety Board video “Combustible Dust – An Insidious Hazard”
- Fires & Explosion history
- Developed a phased approach. Started with Pilot. Defined the cost impact.
- Integrated the risk assessment approach into existing corrective action structure.

The Assessment Plan

- Phase I - Communications, Leadership Endorsement, Training, Guidance, and Testing
- Phase II - Gap Identification
- Phase III – Corrective Action Plan Development
- Phase IV – Corrective Action Closure

Risk Based!!

The Assessment Team

- Global OS&H
- Business unit OS&H
- Engineering
  - Air Systems
  - Electrical
- Risk Management
- Operations Endorsement

Risk Classification Matrix

Combustible Dust Risk Ranking:	Required Action
Acceptable	Fully compliant with applicable standards. Presenting very little risk. No action required.
Low	Requires further control measures. Requires temporary plans followed by permanent mitigation plan. Timing Guideline: 1 to 2 years.
High	Partial compliance with applicable standards. Requires temporary control measures to be implemented followed by a permanent control plan. Timing Guideline: 1 year or less.
Unacceptable	Continued operation at this risk level is not acceptable. Risks at this level requires an action plan approved by the mill manager.

The Combustible Dust Tool Box

- Internal Standards:
  - Fugitive Dust Control & Housekeeping
  - Dust Collector Safety Requirements
- Guidance & Information:
  - Dust Testing Guide
  - Dust Testing Database
  - 6 Element Assessment Tool
- Assessment Process:
  - Standardized dust collection system inventory form and risk assessment.
  - Standardized Assessment Checklist and Reporting

6 Element Assessment

- Dust & Material Testing
- Employee Safety & Training
- Fugitive Dust Control & Housekeeping
- Electrical Systems
- Dust Collector Systems
- Pneumatic Transport & Process Systems

Fugitive Dust Control & Housekeeping Standard

(based on NFPA 654)

- Requires fugitive dust control through engineering controls and process changes.
- Develop overhead surfaces cleaning protocol that relies on vacuum cleaning of accessible surfaces as the primary cleaning method (compressed air cleaning allowed for inaccessible surfaces only).
- Three methods for determining conformance with the new “dust threshold” requirements.
- “Depth” screening chart based on the “Fire” threshold & dust density.

NFPA 654-2011
Dust Threshold Equations

- "Explosion"

$$M_{\exp} = \left[\frac{P_{es}}{DLF}\right] \bullet \left[\frac{C_w}{P_{\max}}\right] \bullet \frac{A_{floor} \bullet H}{\eta_D}$$

- "Fire"

$$M_{fire} = 0.05 \bullet C_w \bullet \left[\frac{P_{initial}}{1 + P_{\max}}\right] \bullet \frac{A_{floor} \bullet D}{\eta_D}$$

Dust Threshold Determination Methods

- Method 1 – Collecting & weighting.
  - "Busy overhead areas"
  - Easiest to implement
  - Most accurate
- Method 2 – Representative area sampling.
  - Time consuming
  - Error prone based on overhead area estimates
- Method 3 –Dust depth.
  - Screening method
  - Inaccurate if accumulations are not uniform

Uniform Tissue Dust Layer Thickness

(NFPA "fire" equation)

		Uniform Dust Layer Thickness, mm/inches				
		Overhead Area above Floor Height (OA), %				
Floor Area (A_{floor}), m^2	Dust Threshold, kg	5	10	20	30	40
500	17.72	22.2 0.86	11.1 0.43	5.5 0.22	3.7 0.14	2.8 0.11
1000	35.45					
2000	70.89					
3000	106.34					
5000	177.23					
7500	265.85					
10000	354.47					

NFPA 654 House-Keeping Practices

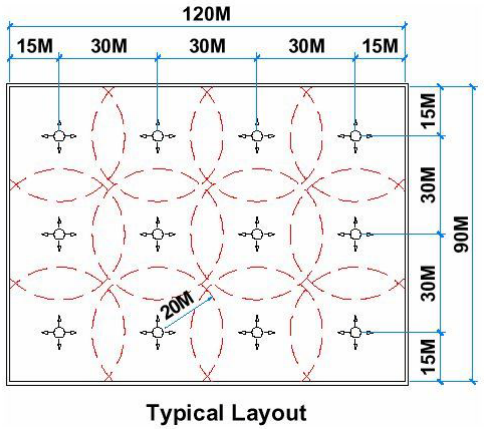
- Vacuum accessible areas prior to use of compressed air.
  - Vacuums must meet dust explosion proof criteria.
  - Compressed air pressure limited to 15 psig.
- Contracted services with 3rd Party
- All electrical circuits not meeting Class II Div 2 must be de-energized, including lifts.

Fugitive Dust Control Long-Term Strategy

- Engineering Solutions
  - Optimize dust collection systems and reduce overhead surface area.
  - Design structural members to minimize dust accumulation.
  - Deploy dust accumulation prevention fans in converting.

Fugitive Dust Control Using Overhead Fans

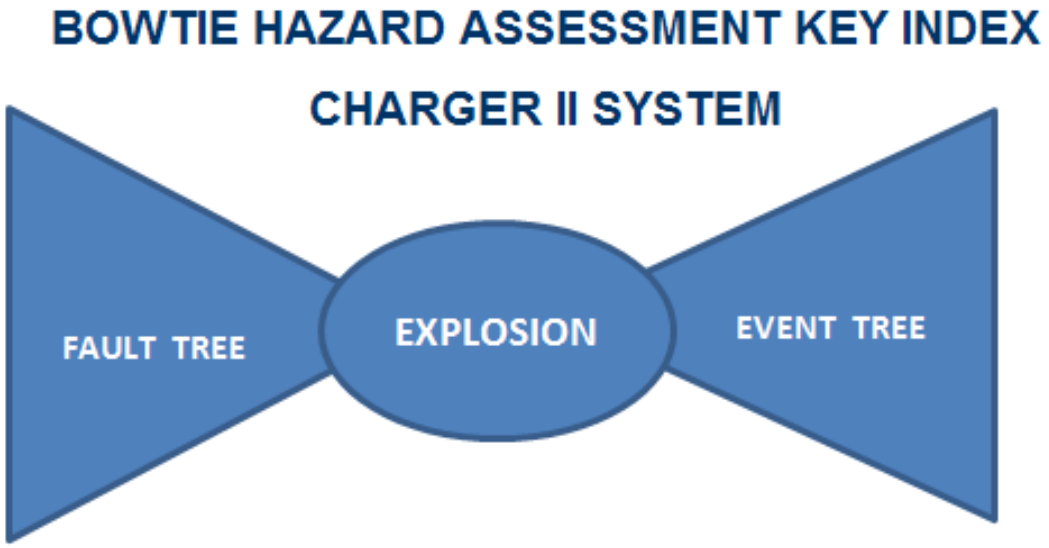
- **Dust accumulation prevention – not removal! Operate continuously.**
- **Oscillating – 360 deg over 15 minute period. 70 deg above to 50 deg below horizontal.**
- **35 - 50 ft reach – Mounted on 50 ft centers.**
- **Tied into the fire detection and suppression system for automatic shut down.**
- **Low ceiling height, obstructions and overhead equipment require careful layout planning.**



Typical Layout

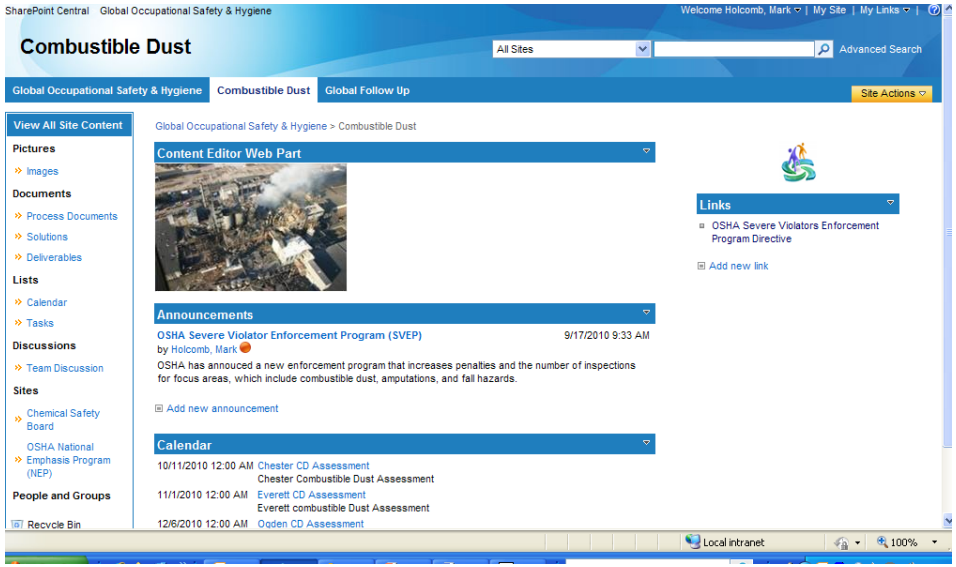
Dust Collector Safety Standard

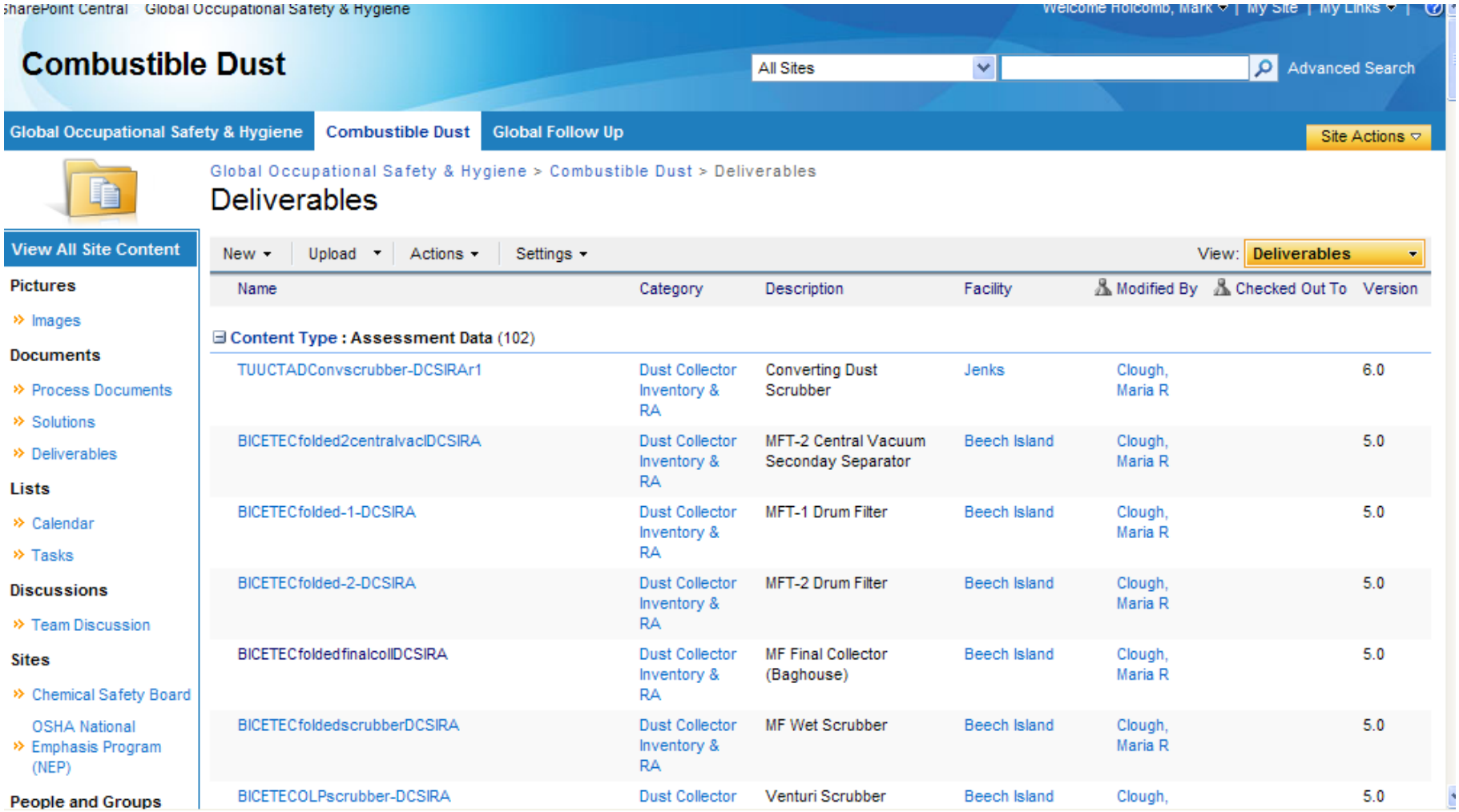
- Established minimum requirements for K-C designs.
- Documentation requirements.
- Standardized risk analysis model.



Project Management Using SharePoint™

- Combustible Dust SharePoint Site.
- Capture and share data.
- Provide access to internal standards and guidance.
- Manage gap closure.




SharePoint Central Global Occupational Safety & Hygiene
Welcome Holcomb, Mark | My Site | My Links
Combustible Dust
All Sites
Advanced Search
Global Occupational Safety & Hygiene
Combustible Dust
Global Follow Up
Site Actions
Global Occupational Safety & Hygiene > Combustible Dust > Deliverables
Deliverables
View All Site Content
Pictures
Images
Documents
Process Documents
Solutions
Deliverables
Lists
Calendar
Tasks
Discussions
Team Discussion
Sites
Chemical Safety Board
OSHA National Emphasis Program (NEP)
People and Groups
New
Upload
Actions
Settings
View: Deliverables
Name
Category
Description
Facility
Modified By
Checked Out To
Version
Content Type : Assessment Data (102)
TUUCTADConvscrubber-DCSIRAr1
Dust Collector Inventory & RA
Converting Dust Scrubber
Jenks
Clough, Maria R
6.0
BICETECfolded2centralvacIDCSIRA
Dust Collector Inventory & RA
MFT-2 Central Vacuum Seconday Separator
Beech Island
Clough, Maria R
5.0
BICETECfolded-1-DCSIRA
Dust Collector Inventory & RA
MFT-1 Drum Filter
Beech Island
Clough, Maria R
5.0
BICETECfolded-2-DCSIRA
Dust Collector Inventory & RA
MFT-2 Drum Filter
Beech Island
Clough, Maria R
5.0
BICETECfoldedfinalcollDCSIRA
Dust Collector Inventory & RA
MF Final Collector (Baghouse)
Beech Island
Clough, Maria R
5.0
BICETECfoldedscrubberDCSIRA
Dust Collector Inventory & RA
MF Wet Scrubber
Beech Island
Clough, Maria R
5.0
BICETECOLPscrubber-DCSIRA
Dust Collector
Venturi Scrubber
Beech Island
Clough,
5.0

Questions