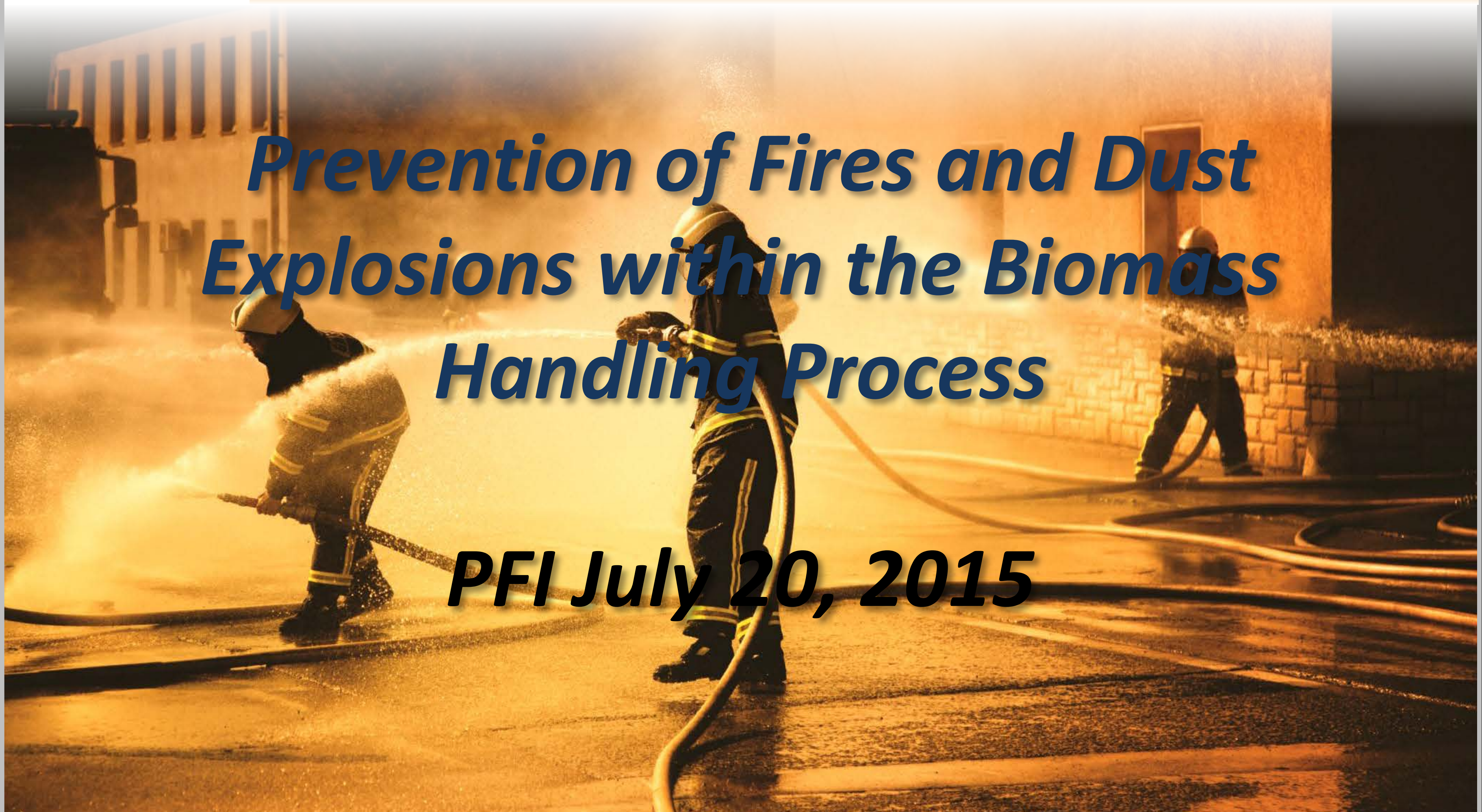


Prevention of Fires and Dust Explosions within the Biomass Handling Process

PFI July 20, 2015

It's not a matter of if - it's a matter of when!

Saturday - July 11, 2015

Port of Brunswick – Georgia

Fire destroys two large wood pellet storage warehouses


The Fire Triangle
Flammable Material
Oxygen
Ignition Source
Dark Particle/Spark
detection systems
All three elements must be present for a fire to occur

Ignition sources generated outside the process

- Hot works
- Truck / front loaders etc.
- Hot surfaces
- Electrical faults
- Over heated lamps
- Etc ……

Many of these can be eliminated by good procedures & maintenance

Ignition sources generated inside the process

- Mechanical friction
- Over heated / blackened material
- Self heating of the handled material
- Breakdown in machinery
- Metal to metal (sparks)

Many of these can be detected early with a Certified Dark Particle/Spark Detection System

Two very important factors tied to the **Biomass Material being produced** is knowing and understanding:

- **What is the Minimum Ignition Temperature (MIT)**
- **What is the Minimum Energy Level (MEL)**

In the risk analysis of the plant, the **MIT** and the **MEL** of the handled material must be tested and verified prior to selecting an appropriate fire prevention system.

Ignition source

Which particles are dangerous?

TABLE 5-9A. Explosion Characteristics of Various Dusts

(Compiled from the following reports of the U.S. Department of Interior, Bureau of Mines: RI 5753, The Explosibility of Agricultural Dusts; RI 6516, Explosibility of Metal Powders; RI 5971, Explosibility of Dusts Used in the Plastics Industry; RI 6597, Explosibility of Carbonaceous Dusts; RI 7132, Dust Explosibility of Chemicals, Drugs, Dyes and Pesticides; and RI 7208, Explosibility of Miscellaneous Dusts.)

Type of Dust	Explosibility Index	Ignition Sensitivity	Explosion Severity	Maximum Explosion Pressure psig*	Max Rate of Pressure Rise psi/sec*	Ignition Temperature† Cloud °C	Ignition Temperature† Layer °C	Min Cloud Ignition Energy joules	Min Explosion Conc oz/cu ft‡	Limiting Oxygen Percentage§ (Spark Ignition)
Agricultural Dusts										
Cellulose	2.8	1.0	2.8	130	4,500	480	270	0.080	0.055	C13
Cellulose, alpha	>10	2.7	4.0	117	8,000	410	300	0.040	0.045	—
Cocoa, natural 19% fat	0.6	0.5	1.1	68	1,200	510	240	0.10	0.075	—
Coffee, fully roasted	<0.1	0.2	0.1	38	150	720	270	0.16	0.085	C17
Corn	6.9	2.3	3.0	113	6,000	400	250	0.04	0.055	—
Cornstarch commercial product	9.5	2.8	3.4	106	7,500	400	—	0.04	0.045	—
Cork dust	>10	3.6	3.3	96	7,500	460	210	0.035	0.035	—
Cotton linter, raw	<0.1	<0.1	<0.1	73	400	520	—	1.92	0.50	C21
Cube root, South American	6.5	2.7	2.4	69	2,100	470	230	0.04	0.04	—
Grain dust, winter wheat, corn, oats	9.2	2.8	3.3	131	7,000	430	230	0.03	0.055	—
Lycopodium	16.4	4.2	3.9	75	3,100	480	310	0.04	0.025	C13
Milk, skimmed	1.4	1.6	0.9	95	2,300	490	200	0.05	0.05	N15
Rice	0.3	0.5	0.5	47	700	510	450	0.10	0.085	—
Soy flour	0.7	0.6	1.1	94	800	550	340	0.10	0.06	C15
Sugar, powdered	9.6	4.0	2.4	109	5,000	370	400‡	0.03	0.045	—
Wheat flour	4.1	1.5	2.7	97	2,800	440	440	0.06	0.05	—
Wheat starch, edible	17.7	5.2	3.4	100	6,500	430	—	0.025	0.045	C12
Wood flour, white pine	9.9	3.1	3.2	113	5,500	470	260	0.040	0.035	—

Enough temperature (MIT for dust cloud)

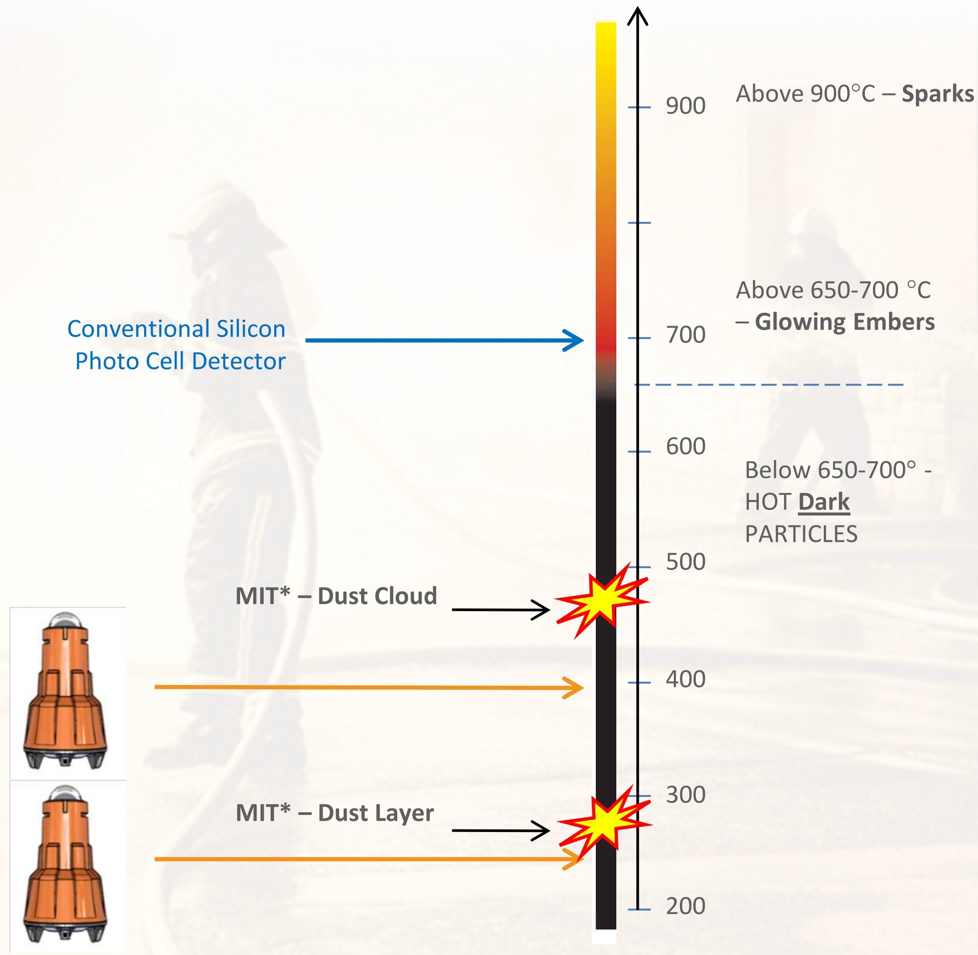
Enough temperature (MIT for dust layer)

Enough energy (MIE)

What should be done ?

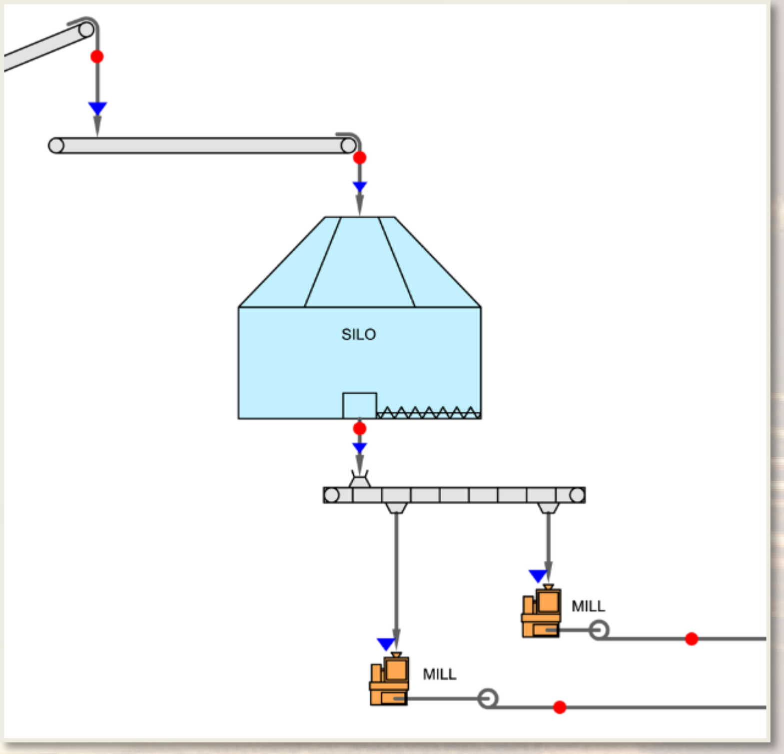
True IR detector type Detects Sparks, Glowing Embers, and Dark Particles from **400°C/752 F**

True IR detector type Detects Sparks, Glowing Embers, and Dark Particles from **250°C/482 F**



Where to locate spark detection systems?

- From the Dryer Outlet and Dryer Cyclones.
- After Mills and Grinders
- Intermediate Storage Bins
- In most Transfer Points
- Infeed to Silos / Warehouse Storage (to prevent ignition sources to entering these areas)
- Outfeed of Silos / Warehouse Storage (to monitor if overheated particles, due to self-heating, are feed out of the silo)
- In all Dust Extraction Ducts to Filters and Bag Houses.

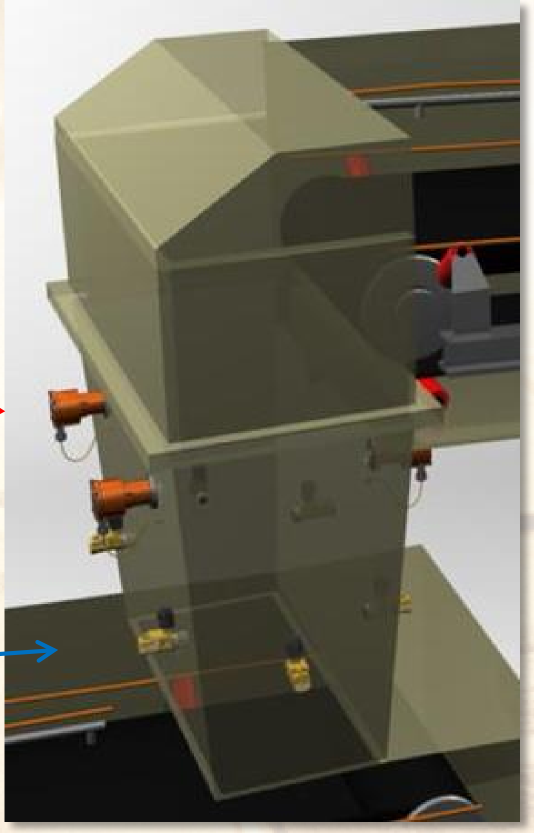


The Spark Detection System

Quick detection and extinguishing of ignition sources inside the process

For the most part, systems are normally located in chutes or pneumatic ducts

Principal of Spark Detection in Chutes and Pneumatic Ducts



Detection zone

Water Extinguishing zone

Single detection
= short water spray

Multiple detections or flame detected
= Water spray + High risk alarm
(Process stop signal is given to the plant PLC)

Process stop signal

The process stop signal is an important function of the spark detection system

- ✓ It will can reverse or stop conveyors and can stop machinery and the infeed of material.
- ✓ It will efficiently minimize the risk for spreading the fire via the conveying system
- ✓ If ignition sources are generated by the machine, stopping the machine will also reduce generation of new ignition sources

Several Various Extinguishing Methods

- Full Cone Water extinguishing
- Water mist
- Steam
- Diverting / isolation of ignition sources
- CO_2 / Inert gas
- Etc….

Research shows that detecting ONLY sparks has less effect than first thought. You need to detect <u>BOTH</u> sparks and dark / hot particles in your process to minimize fires and dust explosions.

* Prof. Rolf Eckhoff, ” Dust explosions in the process industries” (2nd edition)

Thank You!

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