Lessons Learned Database
Individual Incident Summary Report

IChemE
Safety & Loss Prevention
Special Interest Group

Incident Title	**Polyethylene Dust Explosion**		
Incident Type	Dust Explosion		
Date	29th January 2003		
Country	USA		
Location	Kinston, NC		
Fatalities	**Injuries**	**Cost**	
6	38	Unknown	

Incident Description

Credit: US Chemical Safety Board

An explosion and fire occurred at a plant producing rubber drug-delivery components (e.g. syringe plungers, vial seals, septums etc). The semi-continuous manufacturing process involved compounding batches of rubber in mixers, rolling them into strips, and then either moulding them on site or shipping them off site. To reduce the stickiness ("tackiness") of the rubber, the rolled strips were first conveyed through a tank containing a slurry of very fine polyethylene powder in water ("anti-tack" agent). The coated rubber strips were then air dried with fans. The explosion occurred abruptly with while the plant was operating normally. Six workers were killed, 38 more (including 2 responding firefighters) were injured and much of the plant was destroyed.

Incident Analysis

Basic cause was accumulation of fine polyethylene dust above a suspended ceiling in the production area which somehow became dispersed creating an explosive mixture in a confined space which then exploded.

Critical factors included: 1) Polyethylene dust was not identified as a combustible material on the MSDS, 2) The room containing the rubber compounding process had a suspended tile ceiling and a comfort air (HVAC) system that drew air through the ceiling, 3) Small amounts of polyethylene dust will have become airborne as the rubber strips were blown dry, 4) Dust removal from hidden surfaces in the production area (e.g. above suspended ceiling) was not part of the permanent cleaning crew's housekeeping activity, 5) Electrical fixtures and wiring in the production area were not Ex rated, 6) The sprinkler system was rendered inoperable by the explosion.

Root causes included: 1) Inadequate hazard awareness (polyethylene dust not recognised as combustible material), 2) Inadequate risk assessment (ignition risk, hazardous area classification), 3) Inadequate process hazard analysis (consequences of combustible dust dispersion), 4) Inadequate building design (failure to comply with relevant design codes and fire safety standards), 5) Inadequate communication (combustible dust hazard not communicated to employees), 6) Inadequate training and procedures (control of combustible dust hazards).

Lessons Learned

1) A full combustibility assessment should be carried out on all fine powders even if the MSDS does not indicate a combustibility risk.
2) HVAC (comfort air) systems are capable of drawing fine dust through suspended ceilings and into air ducts operating at negative pressure.
3) Housekeeping (cleaning) activity should include all areas of a facility, not just the main manufacturing process area.
4) Dust accumulation significantly increases the risk of a larger secondary explosion with potential for major injuries, fatalities and facility destruction.

More Information

1) "Dust Explosion", US Chemical Safety and Hazard Investigation Board, Report No. 2003-07-I-NC (2004).
2) "Combustible Dust Explosion", US Chemical Safety and Hazard Investigation Board, Safety Digest, April 2018.
3) "Kinston Dust Explosion", Q. A. Baker & M. Kolbe, Proceedings of the 5th International Seminar on Fire and Explosion Hazards, April 2007.
4) HSG103: "Safe Handling of Combustible Dusts – Precautions against Explosions", UK Health & Safety Executive, ISBN 978 0 7176 2726 4 (2003).
5) BS EN 60079 Part 10-2: "Explosive Atmospheres – Classification of Areas – Combustible Dust Atmospheres", BSI (2015).

Industry Sector	Process Type	Incident Type
Pharmaceutical	Rubber compounding	Dust Explosion
Equipment Category	**Equipment Class**	**Equipment Type**
Not equipment related	Not applicable	Not applicable

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