New Approved Screening Tool for Dust Cloud Explosibility!

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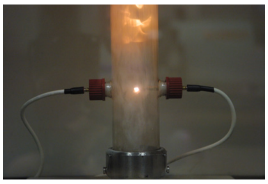
On February 7, 2008 a massive explosion rocked the Imperial Sugar Company facility in Port Wentworth, Georgia. The sugar dust explosion killed 14 workers and seriously injured 36 others, some permanently. Unfortunately, this was not the first dust explosion we had experienced in this country. According to the 2006 USCSB, US Chemical Safety Board, report there have been 281 incidents (fires/explosions) involving combustible dusts having killed 119 workers and injuring 718.

After three large explosions in 2003, which killed 14 workers in total, the USCSB report on the incidents made a recommendation that OSHA develop a workplace dust explosion safety standard to reduce risks. It also recommended that the technical principles that make up the foundation of two key NFPA consensus standards (NFPA 654 and NFPA 484) serve as the basis for an effective OSHA standard. After the Imperial Sugar explosion OSHA made developing a combustible dust explosion standard a top priority.

They have issued temporary instructions to their inspectors in the form of a National Emphases Program which greatly leans on NFPA 654 as a guidance document. The NFPA standard defines a Combustible Dust as "a combustible particulate solid that presents a fire or deflagration hazard when suspended in air or some other oxidizing medium over a range of concentrations, regardless of particle size or shape". OSHA has gone on to identify a deflagration hazard as any dust with a K_{St} (size normalized rate of pressure rise) greater than zero.

For many facilities that are in the processing business, handling powders or generating dusts (sometimes 100's of materials), the requirement to know the K_{St} value for each material can be very expensive and can require months to obtain a complete data set. The advantage of this method is that you do obtain quantitative data for designing an explosion mitigation strategy (vent sizing, explosion suppression and potentially electrical code classification). A simple explosibility screening tool would come in very handy to assess the hazard posed by fugitive and process dust without being overly expensive and time consuming.

Historically, some testing labs have conducted an "A/B Test" as a screening test. This test uses a 1.2-L cylindrical tube as the reaction chamber and a permanent electrical arc as the ignition source. This method has the advantage of requiring only a small amount material for testing and having a very quick throughput of the test; many samples can be tested in a day. However, this method has two serious flaws. Due to the confined geometry of the test vessel and the weak ignition source it can produce many false negatives!



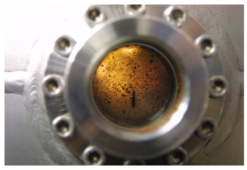
A/B Tester

It can report that a dust is not an explosion hazard in the test apparatus but this same dust may be explosible in a larger process scale scenario. The reader should be very cautious about accepting data that indicates that a dust/powder is non-explosible. Additionally, this screening test method only produces qualitative data which cannot be used for designing an explosion mitigation strategy.

Seeing the shortcoming of both these two dust explosibility test methods described above the ASTM Committee E27 on Hazard Potential of Chemicals (specifically the E27.05 subcommittee "Explosibility and Ignitability of Dust Clouds") decided to develop a screening test methodology which would address the limitations of the two previous methods.

The new screening test methodology has been added to ASTM test method E1226 which has been renamed "Standard Test Method for Explosibility of Dust Cloud". The method is based upon the K_{St}/P_{max} determination experiment but using fewer repeat tests; thus less sample is required for the procedure and turnaround time is very fast. By using the same test geometry and ignition source from the K_{St} test, the possibility of a false negative is eliminated. Additionally, semi quantitative data is produced and the explosion over pressure is quantified. If the explosion pressure and rate of explosion pressure are sufficiently energetic a determination of the Class II nature of the dust/powder can be made for electrical code classification.

20-L Chamber



Sight Lens, 20-L Chamber

However, since the whole concentration range has not been tested sufficiently the maximum over pressure and maximum rate of pressure rise are not determined, so this method cannot be used for vent sizing or explosion suppression strategy design.

Note that since this new screening tool is now part of a well accepted standard its utility for assessing explosible dust for regulatory purposes is greatly enhanced. It is even possible that future NFPA and OSHA standards will reference this screening tool.

For additional details regarding this new ASTM dust explosibility screening tool, please contact :
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