SAMPLE PREPARATION

INTRODUCTION

Particle size distribution of a dust sample can have a significant impact on its explosive behavior. While it may seem logical that testing a sample in the same form as obtained from a process would provide a suitable representation of the hazard associated with a process, it is not necessarily the case. Most dust samples contain a wide range of particle sizes; however, it is the finer particles that are more likely to become lifted and create an explosion hazard. These finer particles will produce more severe explosion indices (P_{max}, K_{St}). ASTM standards, in which the tests are conducted in accordance with, recommend the use of sub 200 mesh (< 75 µm) particles for the determination of dust explosion indices. While Fike is capable of testing particles as they exist within a process, provided they can be dispersed properly, it is always recommended to test the particles that represent the worst case hazard.

Moisture content can also have a significant impact on a sample's explosive behavior. ASTM standards recommend that samples should not exceed 5% moisture by weight in order to avoid test results of a given dust being noticeably influenced.

MOISTURE CONTENT

Every sample that is received in the testing laboratory is tested for the moisture content percentage by weight. It is known that moisture contents in excess of 5% by weight can influence the explosive behavior of dusts. Moisture content testing is generally performed using an Ohaus MB45 Moisture Analyzer. If the sample contains a moisture content of ≥ 5% by weight, the sample will be dried at 150°F for 24 hours in a convection oven prior to testing. This process is performed unless specifically requested otherwise by the customer.

SIEVE ANALYSIS

Generally, a sieve analysis is performed on samples that exceed the upper limit of the laser diffraction particle size analyzer (500 µm). A stack of seven ASTM E11 compliant sieves, incrementally smaller in size, are used during the analysis. A tare weight is determined for each sieve, including the catch pan, and logged on a data sheet. A weighed amount of sample is placed on the top sieve and a lid is placed on top. The stack of sieves is then placed in a Ro-Tap sieve shaker for a period of 10 minutes. After the conclusion of the cycle, each sieve is reweighed and logged on the data sheet to determine the amount of sample that passed through each sieve.

PERCENT COMBUSTIBLE DUST

As shown in OSHA NEP Directive Number CPL 03-00-008, Appendix E, #3, calculating the percent combustible dust is accomplished by multiplying the percent of the sample that passed through a 40 mesh screen and the percent of combustible material.

% combustible dust = (% through 40 mesh) x (% combustible material)

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PARTICLE SIZE ANALYSIS

If the sample is observed to be smaller than 500 µm or if the sample is sieved to a size smaller than 500 µm, the sample will have a laser diffraction particle size analysis performed. The results of this analysis provide the particle diameter at 10, 50, 90%, and the mean diameter. The full particle size analysis also provides a data curve of the particle size and 70 different size 'buckets' with the percentage in that size and a cumulative total.

BULK DENSITY

Historical accidents involving combustible dusts have shown that dust layers on surfaces can be entrained by a disturbance (ie the rupture of a compressed air line or a small explosion) and lead to severe secondary explosions. In chapter 6, NFPA 654 (2013) several methods are proposed to determine if an area has the potential for secondary explosions. One of these methods is called the "Layer Depth Criterion Method" and requires the knowledge of the bulk density of the material.

Bulk density is the measurement of mass per unit volume. The volume of a PVC container and the tare weight (empty) is determined prior to testing. The dust sample is then poured into the PVC container through a funnel positioned centrally 1 1/2" above the container. This process helps prevent large air pockets from forming within the sample. This method generally follows *Apparent Density, Test Method A* of ASTM D1895-96 (2010) *Standard Test Method for Apparent Density, Bulk Factor, and Pourability of Plastic Materials*. Once the container is filled, the excess material is removed with a wide spatula using caution not to compact the dust in the container. Next, the weight differential between the filled and empty container is measured using a high precision scale. The weight of the dust divided by the volume of the container represents the bulk density of the sample in test. This measurement is made four times and the average value is reported as the bulk density. In making this measurement, every effort is made to eliminate compaction of the sample while measuring the bulk density.

GRINDING

Fike has the ability to perform sample reductions on most materials. Samples may be ground by using a high-speed ball mill, a centrifugal cutting mill, a heavy-duty analytical mill or a mortar and pestle set. Most samples can be ground by one of the methods alone however samples with low melting points tend to melt during the grinding process. If this occurs, the centrifugal cutting mill has the capability to operate with dry ice to keep the mill (and the sample) cool during the milling process. Some materials are not able to be ground (ie fibrous materials). Heat generated during the milling process may reduce moisture content on sensitive samples.

SIEVING

Sieving is performed using ASTM E11 *Standard Specification for Woven Wire Test Sieve Cloth and Test Sieves* compliant test sieves. Samples with high electrostatic charges may not pass through a sieve. A PSA may help determine the size of the particles attempting to be sieved. The sieves are used in conjunction with a Ro-Tap sieve shaker to achieve greatest results.

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