Combustible dust analysis

Dust explosions may have a devastating effect with lethal outcomes or cause damage to personnel and property. Often these accidents occur at sites with no former dust explosions which may lead to a false sense of security. As a matter of fact, the risk is evident at several industries and should be handled to prevent accidents.

Is your site subject to dust explosion hazards?
Most organic materials, e.g. wood, flour, paper, paint pigment and plastics but also some inorganic materials, such as various metal dusts, are able to create an explosive atmosphere if the particles are fine enough and have the right concentration dispersed in air. Combustible gases and fluids have known explosion properties which are stated in their material safety data sheets, but for dust and powder it is not as simple. Defining the explosive properties is vital to attain a safe plant design and operating conditions.

Dust explosion testing
RISE have the most well-equipped laboratory in Sweden for analyzing combustible dust, with dedicated test engineers and researchers specialized in fire safety, explosions and risk assessment. We offer a wide range of services to help companies investigate and limit explosion hazards.

Source of ignition: The dust needs energy to ignite. The energy can originate from a small source of static electricity or larger source, such as a naked flame, electrical malfunction, or by self-heating if the dust is resting on a hot surface.

Fuel: The particle size distribution is important, smaller particles are more easily ignited and will be better dispersed in air. The concentration is also important and needs to be within a given range in order to create an explosive dispersion.

Oxidant: To support and maintain the combustion an oxidant is required. Usually oxygen in air is enough to create an explosive atmosphere.

Mixture: The dust needs to be airborne. Inside various process equipment the particles are frequently dispersed into the air. Furthermore, also dust which is not usually airborne can be lifted due to a primary explosion or other circumstances.

Containment: If the explosion occurs in a confined area the pressure rise may develop in a very fast manner, which can cause severe damage to personnel and property.
With our equipment we can determine the following explosive characteristics for dust:

Modified Hartmann tube:
ISO/IEC 80079-20-2
A yes/no method to determine if the dust is combustible or not. If ignition occurs further testing is recommended.

MIE – Minimum Ignition Energy:
ISO/IEC 80079-20-2, EN 13821
The minimum energy required to ignite an explosive atmosphere. Testing can be performed without increased inductance to simulate common electrostatic discharges or with increased inductance, corresponding to e.g. mechanical sparks or sparks from faulty electrical equipment.

MIT\textsubscript{dc} – Minimum Ignition Temperature of dust cloud:
ISO/IEC 80079-20-2, EN 50281-2-1
The lowest temperature of a hot surface which will ignite an explosive atmosphere. The test measures at which temperature a dust cloud in contact with, for example, a hot pipe, will ignite.

MIT\textsubscript{dl} – Minimum Ignition Temperature of dust layer:
ISO/IEC 80079-20-2, EN 50281-2-1
The lowest temperature where a dust layer resting on a hot surface will ignite. The test simulates dust gathered on equipment, for example, and at which surface temperature the dust will ignite.

$P_{\text{max}}$ – Maximum explosion pressure:
EN 14034-1
The maximum explosion pressure attained in a 20 L sphere. Together with the rate of pressure rise these are essential data to be able to properly dimension vent sizing etc.

dt/dt och $K_{\text{St}}$ – Maximum pressure rise rate and dust explosion constant (severity):
EN 14034-2
An indication of how fast the pressure rises in the 20 L sphere and the corresponding pressure rise in a 1 m\textsuperscript{3} vessel. This value is the basis for the St-classes.

LEL/MEC – Lower Explosion Limit:
EN 14034-3
Lower explosion limit/minimum explosive concentration of dust which is ignitable in atmospheric conditions.

LOC – Limiting Oxygen Concentration:
EN 14034-4
Determination of the lowest oxygen concentration required to sustain an explosion.

Test of resistivity:
ISO/IEC 80079-20-2
An indication of the electrical conductivity of the dust. High resistivity equals low conductivity. The risk of accumulating electrostatic charges increases with increasing resistivity.

Sample preparation and characterization:
The particle distribution and the moisture content are of eminent importance for the dusts' explosive character. Generally smaller particles of dust generate a stronger reaction, since finer particles have a larger specific area (i.e. area per mass) and combustion is more easily spread between smaller particles. According to the EU regulations testing is performed on particles with diameter <500 µm. Moisture content shall be declared but there is no recommended range specified. Therefore, testing is usually performed either at the received moisture content, which the dust normally has in the process, or it can be dried to simulate a worst case scenario. RISE provides sample preparation and chemical characterization of both organic and inorganic materials.

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