Dust Explosion Property Tests

Part of Gexcon's Fire and Explosion Testing Services

Dust Explosion Property Tests

Gexcon offers a wide range of standardized tests for the determination of the ignition and explosion properties of dusts. Being aware of these properties of materials handled in your plant or used in your products will allow you take the necessary safety precautions and to prevent explosions and to reduce the consequences.

General Information

If information about the particle size distribution of the dust/ powder sample(s) is available, please send it together with the order and it will be included in the test report.

A material safety data sheet (MSDS) shall always be attached to the sample(s) or sent by e-mail prior to the shipment of the sample(s) to ensure safe handling and disposal. The standard prices are not valid for toxic samples. Toxic samples may be tested for an additional fee.

If a MSDS is not available or not deemed satisfactory according to Gexcon's requirements, to allow safe handling and testing, Gexcon reserves the right to refuse or delay the testing of the sample(s) until safety issues are resolved. If the sample(s) has already been received it will be returned at customer's expense (shipping and administrative expenses).

The tests will be performed as soon as possible after the samples have been received, which is normally within 2-4 weeks depending on the current testing backlog in the laboratory. Testing status and progress will be communicated throughout the period of testing. A test report will be written when all results are available.

Further advice, data analysis and interpretation of results given in the test report are not included and is subject to extra cost at hourly consulting rates.

After the test report has been issued, the excess material will usually be kept for four weeks, but can be stored for up to one year subject to a storage fee. After this period (4 weeks – 1 year) the material will be disposed or returned to the customer (disposal or shipping costs and administrative expenses will be charged). Excess material that must be disposed of as hazardous waste will also be charged. Any freight and/or customs fees incurred by Gexcon following receipt of the test samples will be invoiced to the customer.

Explosibility test (Yes/No)

The result from the test gives information whether the dust sample is combustible or not.

If the result shows that the sample is combustible, it is recommended to perform other tests to be able to take precautions against dust explosions and fires in the process. Gexcon performs explosibility screening testing using the 20-litre explosion apparatus. Powder or dust samples of various sizes are dispersed inside the sphere and are exposed to a 2 kJ ignition source (chemical igniters).

The explosibility test is performed according to the Kühner AG 2009: “Operating Instructions 20-l-Apparatus”, Ver. 7.0.

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Minimum Ignition Energy Test - Dust Cloud

The minimum ignition energy (MIE) test is used to assess the potential vulnerability of powders and dusts (as dispersed clouds) to ignition. When the MIE test is carried out with a significant or non-negligible inductance in the ignition circuit, the test yields the ignition sensitivity of the dust cloud to ignition from electrical sparks. This is also relevant for frictional or “mechanical” sparks. The inductance in the ignition circuit is used to increase the spark duration.

For ignition hazards related to electrostatic discharges the MIE test should ideally be performed using an ignition circuit without inductance giving representatively weaker and short duration sparks.

Gexcon performs MIE testing in accordance with EN 13821 2002: "Potentially explosive atmospheres – Explosion prevention and protection – Determination of minimum ignition energy of dust/air mixtures", using the MIKE3 or the Modified Hartmann Apparatus. Powder or dust samples of various sizes are dispersed in a 1.2- litre vertical tube and attempts are made to ignite the resultant dust cloud with discrete capacitive sparks of known energy. The following energies are used in the MIKE3 apparatus: 1, 3, 10, 30, 100, 300 and 1000 mJ (with or without inductance).

The Modified Hartmann Apparatus may also be used on request for the following energies: 2, 5, 10, 15, 20, 50, 100, 200 and 2000 mJ, but this apparatus is rather conservative when considering ignition sources resulting from electrostatic discharges only.

Minimum Ignition Temperature of dust clouds (MITdc)

The MITdc (dust clouds) test is used to assess the hazards of hot surfaces for a dust cloud. The parameter can be used to limit surface temperatures to safe levels. The residence time of the dust cloud in the hot furnace is however limited. Therefore this determination is relevant only for situations where a dust cloud can be in brief contact with a hot surface. Examples of such situations can be found where steam pipes or electrical equipment are present. For the assessment of the hazards from mechanical sparks the MITdc as well as the MIE must be known.

The minimum ignition temperature (MITdc) test determines the lowest surface temperature capable of igniting a powder or dust dispersed in the form of a dust cloud. The MITdc is an important factor in evaluating the ignition sensitivity of powders and dusts and is relevant for defining the maximum operating temperature for electrical and mechanical equipment used in dusty environments.

MITdc testing is performed using the Godbert-Greenwald Furnace in accordance with EN 50281-2-1 1998: Part 2-1: Test methods: “Methods for determining the minimum ignition temperatures of dust”. Powder or dust samples of various sizes are dispersed into the furnace and the minimum wall temperature capable of igniting the dust cloud is determined.

Minimum Ignition Temperature of dust layers (MITdl)

When determining the minimum ignition temperature of dust layers, i.e. (MITdl), one describes the minimum ignition temperature for a dust layer of a given thickness that is resting on a hot surface. The MITdl is the lowest temperature of a heated free surface for which a dust layer of 5 mm deposited on it will ignite (starts smouldering). The MITdl of a dust is used together with the MITdc (for a dust cloud) to define the maximum operating temperature for electrical and mechanical equipment used in dusty environments.

The test involves heating a circular layer sample 5 mm thick and 100 mm in diameter on a hot plate at constant temperature. In order to assess the sensitivity of the dust to layer thickness, a 15 mm thick layer can also be tested in addition to the 5 mm layer. The temperature of the sample layer and the hot plate are monitored and the minimum surface temperature capable of igniting the powder or dust layer is determined. In practice, the following hot surfaces may exist: surfaces of hot equipment, heaters, dryers, steam pipes and electrical equipment.

This test is also performed according to EN 50281-2-1 1998: Part 2-1: Test methods: “Methods for determining the minimum ignition temperatures of dust”.

Explosion pressure development (Pmax, dP/dtmax and KSt-value)

The maximum explosion pressure forms the basis for explosion protection by design and construction of equipment, protective systems and components to reduce the explosion effects. The maximum explosion pressure can be used when designing explosion proof equipment. The maximum explosion pressure, together with the Kst-value, are used for dust explosion vent sizing.

The result gives information on the necessary size of vent openings (to see whether the existing ones are sufficiently large). The explosion pressure development is performed in the 20-litre sphere apparatus with a strong ignition source (10 kJ). The sample size is varied to determine the optimal dust cloud concentration. The maximum pressure and rate of pressure rise are measured and used to determine the Kst-value and St hazard class of the material. These data can be used for the purpose of designing dust explosion protection measures and equipment.

The investigation is performed in the 20 litre spherical vessel according to EN 14034-1:2004+A1:2011: "Determination of explosion characteristics of dust clouds - Part 1: Determination of the maximum explosion pressure pmax of dust clouds" and EN 14034-2:2006+A1:2011: "Determination of explosion characteristics of dust clouds – Part 2: Determination of the maximum rate explosion pressure rise (dP/dt)-max of dust clouds”.

Lower Explosion Limit (Min. Explosible Dust Concentration) (LEL)

The lower explosion limit (LEL) test determines the smallest concentration of material in air that can give rise to flame propagation upon ignition when in the form of a dust cloud. The test involves dispersing powder or dust samples in a vessel and attempting to ignite the resulting dust cloud with an ignition source (2 kJ). Trials are repeated for decreasing sample sizes until the LEL is determined. The parameter is used for assessing dust explosion hazards inside dust handling equipment.

The test is performed according to EN 14034-3 2006: "Determination of explosion characteristics of dust clouds - Part 3: Determination of the lower explosion limit LEL of dust clouds".

Limiting Oxygen Concentration (LOC)

The limiting oxygen concentration is used when applying inerting. LOC testing is performed using the 20-litre sphere apparatus. Powder or dust samples of various sizes are dispersed in the vessel and attempts are made to ignite the resulting dust cloud with an ignition source (2kJ). Trials are repeated for decreasing oxygen concentrations until the LOC is determined. It should be emphasised that the LOC is inert gas type dependent because of different capacities of these inert gases. Gexcon usually use nitrogen as inert gas. If desired, another inert gas can be used during testing. Nitrogen has a higher heat capacity than e.g. argon and the result of the LOC value found for nitrogen may therefore be higher than in an atmosphere where a part of the oxygen is replaced by argon.

Determination of the limiting oxygen concentration for inerting of dust clouds is performed in the 20 litre spherical vessel according to EN 14034-4 2004: "Determination of explosion characteristics of dust clouds - Part 4: Determination of the limiting oxygen concentration LOC of dust clouds".

Minimum ignition temperature of dust deposits (self-ignition) (SIT/AIT)

The self-ignition temperature is used to assess ignition hazards due to self-heating during bulk storage of materials. Self-heating is most commonly due to oxidation processes. Locally, oxidation processes generate heat which, due to the insulation properties of the powder, is not easily transferred to the environment. Locally the surrounding dust particles are heated up slightly, resulting in faster oxidation. This will lead to even more local heating. If the heat transfer to the surroundings is not sufficient this process could lead to high temperatures in dust heaps and even in ignition of the dust.

Self-heating properties of dusts and powders are investigated according to EN 15188 2007: "Determination of the spontaneous ignition behaviour of dust accumulations".

Dust Layer Flammability Test (DLFT)

This test is performed in order to see whether a dust layer may propagate a smouldering combustion. Based on the reaction and spreading properties of the fire, the dust is classified into different classes.

This is done according to VDI-GL 2263 Part 1 1990: "Test methods for the determination of the safety characteristics of dust, Burning behaviour".

Specific resistance ρ in Ω*m or Ω*mm²/m

This test is done according to EN 61241-2-2:1995: "Method for determining the electrical resistivity of dust in layers".

Your benefits

Gexcon believes in individual approach because we believe each client has different test preferences. Please contact our team and we will discuss together on which test(s) is suitable for you. We also offer you:

- Detailed price transparency depending on your test preferences
- Detailed test report

About Gexcon

Gexcon is a world-leading company in the field of safety and risk management and advanced dispersion, explosion and fire modelling. Our experience arises from detailed knowledge of explosion phenomena built up throughout years of conducting extensive research projects, carrying out safety assessments, performing accident investigations, and performing physical testing at the company's facilities.

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