Telemecanique Sensors
When dust explodes

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Simply easy!

Telemecanique
Sensors

Dust can be much more than just a housekeeping issue!

Dust is small solid particles that can remain suspended in the air for a certain amount of time and then settle under the effect of their weight.

Dust can be manufactured for a specific purpose (like flour), be generated during the processing of solid materials (like sawdust from cut wood) or result from the abrasion of solid materials during transportation (like cereals).

All dusts capable of undergoing exothermic reactions with air when ignited **are capable of causing an explosion under certain conditions**. This phenomenon has been recognized since the beginning of the industrial era in many fields (wood industry, mining, food processing, metalworking, chemistry…). Dust explosions are still very common today despite the efforts of authorities and businesses.

Dust explosions can originate from [but are not limited to]:

- Plants (bark, cork, cotton, wood, ...)
- Food (starch, sugar, flour, ...)
- Metal (aluminum, magnesium, ferroalloys, ...)
- Industrial materials (plastics, fabrics, powdered waste, paper, cardboard, ink...)

The risk is amplified by industrialization, mechanization, automation, increased storage capacity, higher handling speeds and the growing number of products present in powder form with increasingly smaller particle sizes. When the particle diameter is less than 500 microns (European standard) or 420 microns (material passing a No. 40 U.S. Standard Sieve) this risk has to be taken into account [(1)].

“Dust explosions are still very common today, causing injuries and even numerous deaths every year”

[(1)] This dimension is indicative: INERIS, French notify body reports a feature for irregularly shaped products and particle size greater than 1 mm (floccules buts, fiber), which can still form an explosive atmosphere).

The cause of dust explosions

There are 5 conditions required for an explosion to happen.

1. There must be an oxidant

Typically, the oxidant is the atmospheric oxygen.

2. There must be a combustible substance

The combustible substance, in relation to dust explosions, **is dust suspended in the air at a sufficiently high concentration** with at least a portion of the particles smaller than 500 microns. It is this concentration of the dust in the air of a given area (called the Explosive Field) that makes the dust a "combustible substance." The minimum concentration of dust necessary to make an explosion possible varies depending on the type of dust it is (wheat: 65g/m3, aluminum 40 to 120 g/m3, uranium 45g/m3, charcoal 40g/m3 polyester 45g/m3). The size of the dust particles, which makes the concentration in the air higher, is a very significant factor.

The suspension of the dust particles in the air can be caused by, among other things, movements (of conveyor belts, vacuums, etc.), by improper cleaning (operating blowers, sweeping), or by a preceding explosion (which blows a concentration of deposited dust into the air, causing a second, sometimes more devastating explosion). Inappropriate use of a powder or CO2 fire extinguisher can also suspend a dangerous amount of combustible dust in the air.

"The finer the dust, the greater the risk "

3. There must be an ignition source :

The ignition source can vary based on the type of industrial machinery present. A few examples of ignition sources that can ignite dust particles in the air are:

- Sparks caused by friction, static electricity, electrical equipment.
- A flame
- A hot surface
- Heat generating tools (welding, etc...)
- Lightning
- High air temperatures[2]

4. The dust must be dispersed

The dust must be dry and in suspension to cause an explosion.

5. A confinement of dust

Confinement is not an essential condition for an explosion to occur, but can greatly aggravate the physical damage that results.

"The complexity of the phenomenon and the number of parameters make the occurrence of a dust explosion random"

[2] High air temperatures can cause an ignition if the dust (suspended in the air or deposited) is at a temperature above its own auto ignition level (300 to 600°C, with some exceptions such as uranium and its hybride: 20°C)

The industries affected by dust explosions

Listed below, in descending order of reported occurrences, are the industries affected by dust explosions

1. Industries whose processes generate dust:

- Mechanical woodworking
- Mechanical metal working
- Paper and cardboard industry
- Textile industry
- Coal power plants (lignite)

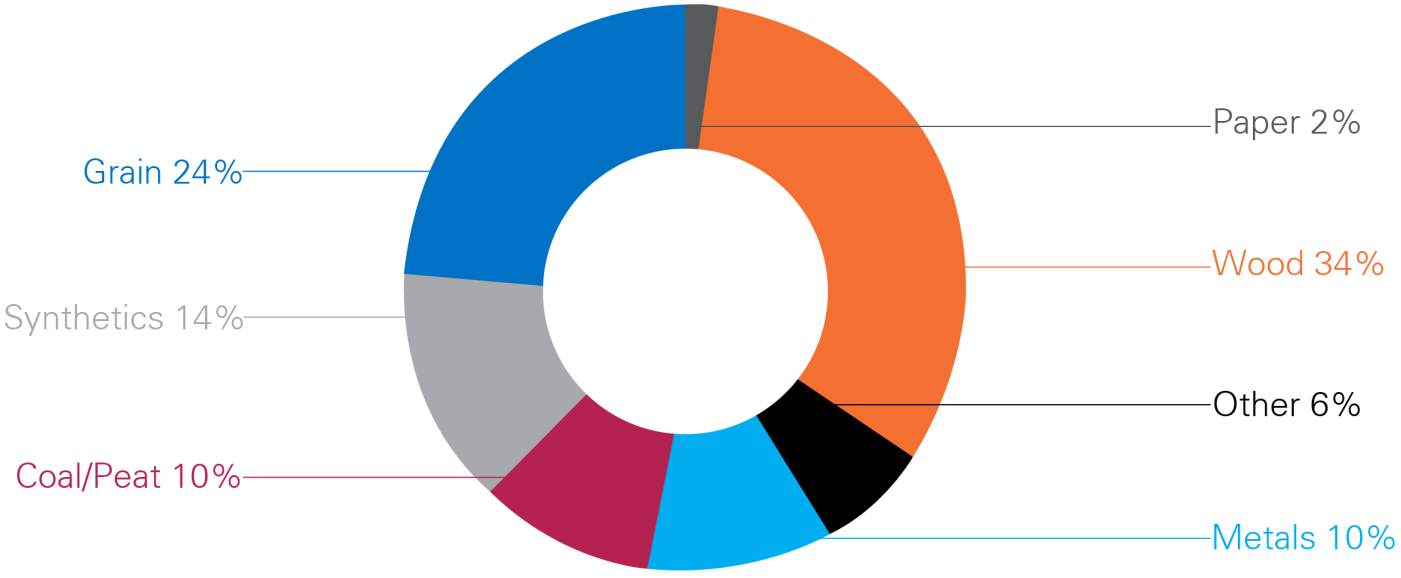
2. Food industries employing powdered ingredients:

- Manufacture of animal nutrition
- Mill
- Bakery

3. Grain storage facilities:

- Cereals: wheat, barley, oats, rice, rye, corn
- Oilseeds: sunflower, rapeseed, soybean, cotton, palm
- Protein crops: peas, beans, lupins.

Most common types of dust explosions



Source : UN discussions on Dust Explosion Hazards, January 2016

Preventing dust explosions

To guarantee the highest possible level of safety in these industries, the legislatures of most countries have developed appropriate guidelines in the form of laws, regulations and standards.

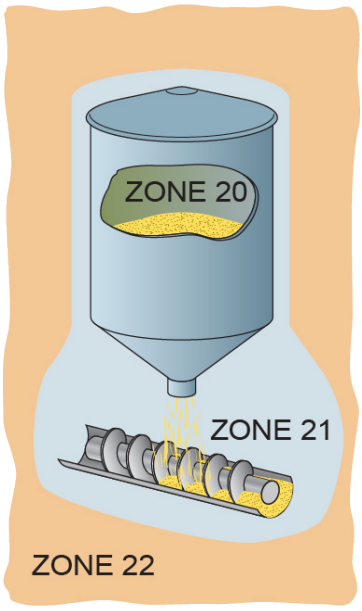
For international electrical equipment, the IEC is trying to finalize a "single global test and certificate" called the IECEx Scheme (www.iecex.com).

The European Union has created the prerequisites for complete standardization. All related electrical devices **must** satisfy the European Directive **ATEX**[3] 94/9/CE (a new directive called ATEX 2014/34/EU began to apply since April 2016 and manufacturers have up to 2 years to update their certifications).

The US National Electrical Code **(NEC)** and the Canadian Electrical Code (CEC) define hazardous areas in 2 different ways: NEC 502 (Class/Division) and NEC 506 (Zone System).
Class/Division method is still the dominant method used in North America even if they are trending more towards the Zone System.

ATEX, IECEx and NEC 506 use the same protection concept: **The Zone System.**

The Zone System defines the probability of the hazardous material (dust) being present in sufficient quantities to produce explosive or ignitable mixtures.
Zone 20 - An area where combustible dusts or ignitable fibers are suspended in the air continuously or for long periods of time.
Zone 21 - An area where combustible dusts or ignitable fibers are likely to be suspended in the air under normal operating conditions.
Zone 22 - An area where combustible dusts or ignitable fibers are, under normal operating conditions, not likely to be suspended in the air and do so for only a short period of time.



Grain Silo

[3] ATEX is defined by AT: atmosphere and EX: explosive.

Each zone is divided into groups and subgroups. They are also assigned a temperature code defining the protection concept for which electrical equipment utilized in those zones have to comply.

Telemecanique Sensors is proud to offer various ranges of Sensors that are ATEX certified for use in all Zone 21 applications. These safety-enhancing, ATEX certified products are listed below:

Limit switches, pressure switches, and inductive sensors:
www.tesensors.com/ATEXswitches

Safety switches combining safety and APEX approvals:
www.tesensors.com/ATEXpreventa

Cable pull switches combining safety and ATEX approvals:
www.tesensors.com/ATEXcablepull

Discover Telemecanique Sensors offer, compliant with explosive atmosphere environments (zone 21)

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