# Wood Industry Explosion Protection

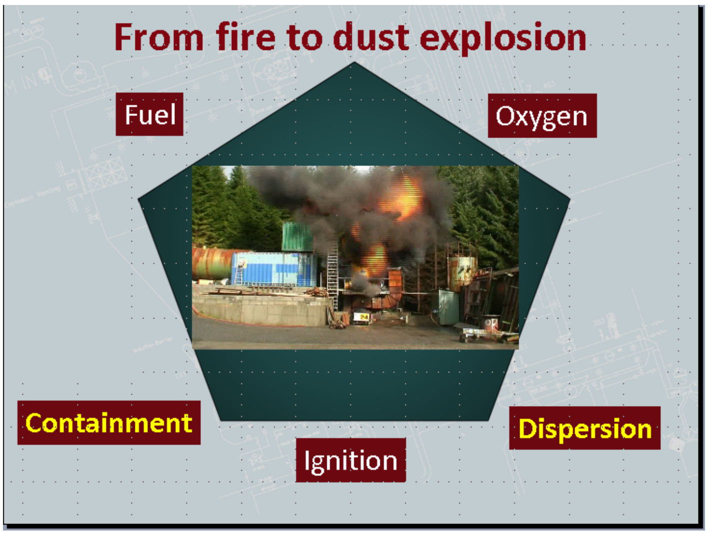
What implications does this have for safety? If you look at the news section of our website, www.explosionhazards.com explosions are being reported every month from Wood processing facilities, saw dust mills, even the biomass pellet drying plants are having incidents. In the UK the most recent tragic event at Wood Flour Mills in Bosley Cheshire in July 2015 where the site was also struck by fires in 2010 and 2012. Wood is processed at the plant into a fine powder and the resulting “wood flour”, with a consistency like sand, is used to make laminate flooring. Only days later search teams had found all the bodies under the rubble. This highlights the need for closer scrutiny of wood as an explosive dust, especially as the larger power plants convert from coal to wood pellet biomass.

**Back to basics**

In deciding our philosophy for Explosion Prevention and Protection, we need to identify the components of the basic fire triangle; Fuel, oxygen and ignition, with the further components especially for dust explosions; of dispersion and containment.

**The Fuel**

So what are the primary fuels: wood, grasses, and grains, sludge pellets, agricultural and municipal wastes, flour sugar and even Milk powder for your babies’ formula!




**Oxygen**:

Many industries have oxygen reduced atmospheres as their primary prevention/protection against fire and explosions. The Cement industry has a long history of using re-circulated exhaust, with Nitrogen and CO2 to extinguish or inert the hazardous atmosphere. The steel industry has an abundance of nitrogen which it is now using to inert its plant and reduce its reliance on explosion venting. Most industry use air in their process so Oxygen is unavoidable.

**Ignition Sources:**

The ATEX standards EN 1127 or the HSE websites give exhaustive lists of Ignition sources
Many times a change in fuel may totally change the normal ignition sources in a facility

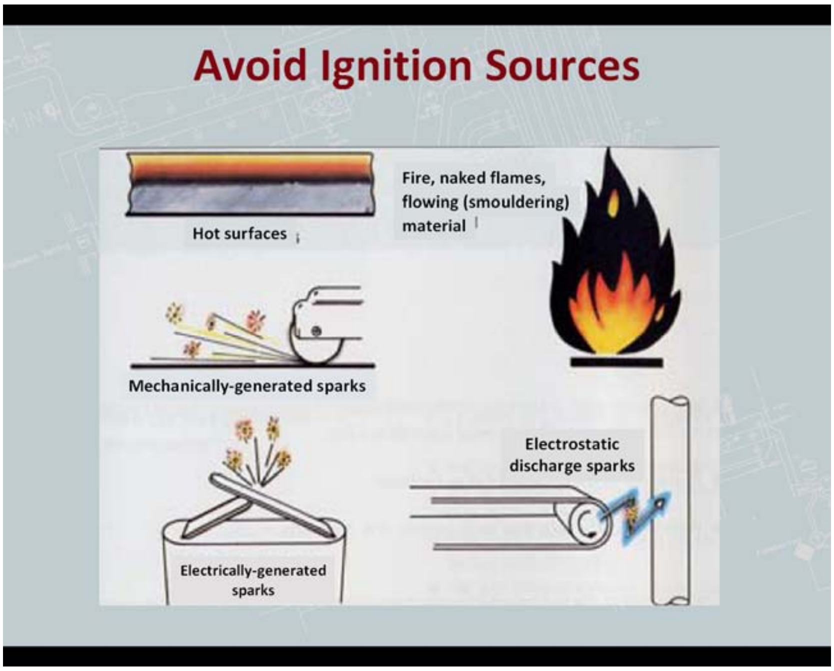
Ignition sources may be:

- Flames; Direct fired space and process heating; Use of cigarettes/matches etc;

- Cutting and welding flames; Hot surfaces; Heated process vessels such as dryers and furnaces; Hot process vessels; Space heating equipment; Mechanical machinery etc…

Sources of ignition should be effectively controlled in all hazardous areas by a combination of design measures, and systems of work:

- Using electrical equipment and instrumentation classified for the zone in which it is located. New mechanical equipment will need to be selected in the same way.
- Earthing of all plant/ equipment etc….




**The containment**:
Are we talking about a 0.5 barg filter or a 2 bar Roller mill / pressure shock resistant silo?

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What about 6 bar vessels that may deform but never rupture or a fully contained 10 bar vessel with no deformation. Do we need to isolate the propagation of flame/explosion between these vessels?

Industry processes used to convert the fuel to energy:

- Direct combustion of biomass material. Some processing may be carried out prior to combustion e.g. sorting, chipping, pelleting or drying.
- Thermochemical processes - where solid is upgraded to a liquid or a gas by pyrolysis and gasification
- Decomposition of solid to liquid or gaseous fuels by processes such as anaerobic digestion and fermentation.
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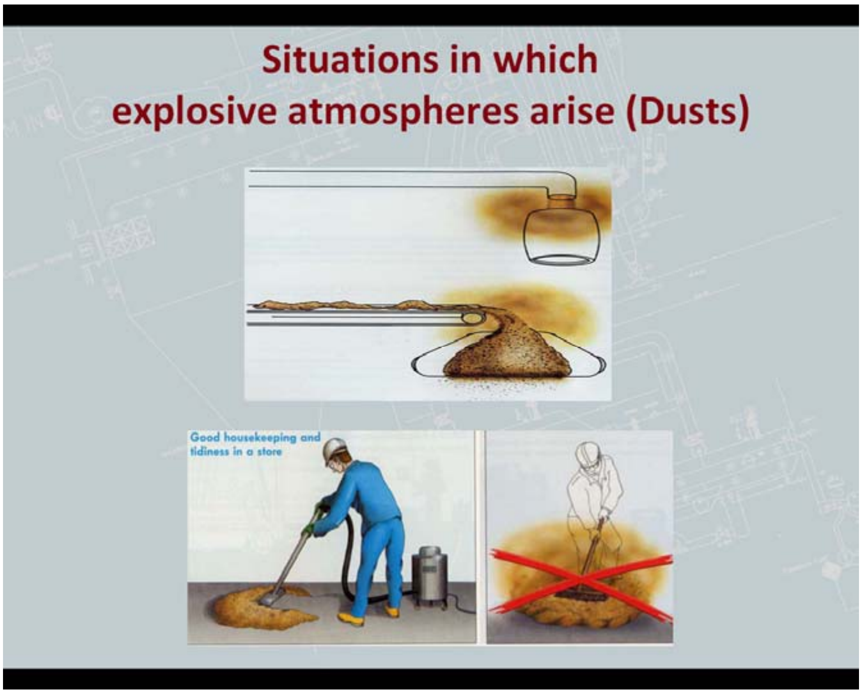
Also extremely popular are combined heat and power (CHP) and down to your more domestic Wood stove burners.

**Dispersion:**

It is generally accepted that most carbon based products have a lower explosion level of 30 to 60 g/m3. We illustrate to clients that you cannot “see the hand on the end of your arm” at greater than 30g/m3. In the USA they have a rule of thumb; if the dust layer is “greater than the thickness of a dime” you have a problem. When bringing fuel in on conveyors, road or rail, you will have attrition, and settling of a percentage of the dust fines. Wood pellets from over seas will have large percentages of fines at the bottom of their hull. Does that mean that the last 3 train loads coming into a power plant contain only fines? Whether you use dry fog or spot filtration you will have accumulations of dust either in the duct or at the final collection points or filters. Dropping product large distances from the top of a silo creates dust dispersion. Plant during start up and shutdown or during cleaning or abnormal operations, may also create dust clouds. Many incidents still happen from air jet cleaning, simple room blowers or brushing instead of vacuuming.



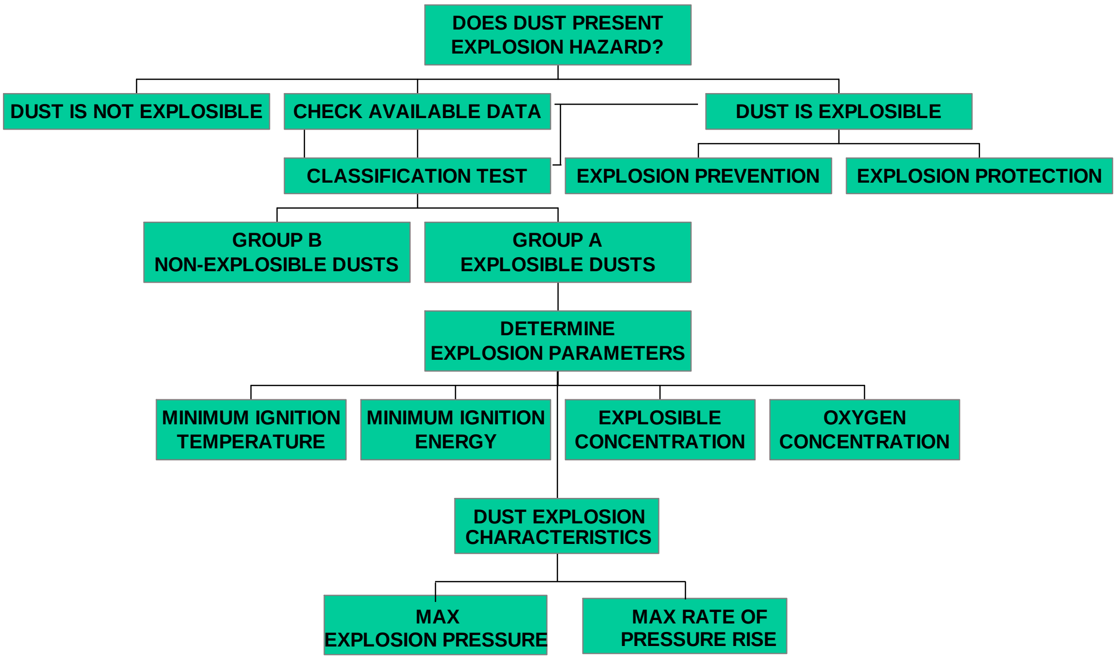

**Prevention and Protection**

There are 2 primary approaches to Fire and Explosion protection in any industry:

1. Prevention; what do you do, to prevent the event ever happening. This involves in any industry, good design practises, Risk assessment, Hazard identification and consequences, implement good risk reduction measures, document every step in the process, good training and management responsibilities should be put in place, operating procedures should be established and reviewed frequently, good engineering practices, quality monitoring of all safety aspects above. Typical equipment options are spark detection, dry fog, and gas or temperature monitoring, alignment sensors.

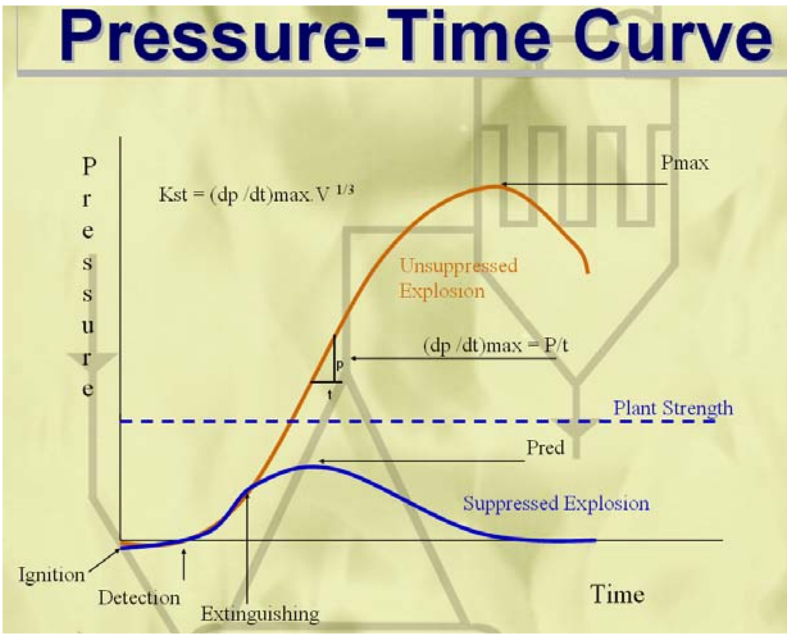
2. Protection; despite all your best prevention systems being in place you now must protect your people and plant from the harmful effects of that event and minimise the consequences. Typical equipment options are containment, (6 to 10 bar) barriers or rotary valves or Explosion Venting either with Doors (self-reclosing) or vent panels sometimes incorporated into flameless assemblies for indoor venting. Suppression and or chemical barriers using dry chemical are an alternative if the other systems are not practical. Other less frequently used options are product plug, screw chokes, and Slamshut valves. Many wood applications still use Flap valves and flame diverters but they are being challenged as real explosion Isolation devices by ATEX. Proper and safe process shutdown procedures are critical to prevent an escalation of the event as secondary explosions are frequently worse than the original event.

**Systematic Approach to Industrial Explosion Problems**
When deciding your hazard in any industry everyone has to define the problem this frequently involves a systematic approach
Does the product pose as an Explosion Hazard, well obviously if the product is going to be used as a fuel, it probably combustible! So we can dispense with the A/B classification test.




**<u>Generic wood values</u>**
95% < 75µm Particle size less than 500 µm is potentially explosive, less than 5% moisture
Maximum Explosion Pressure in an Explosion test rig; Pmax = 6.5-7.0 bar
Maximum speed of the explosion, relative to a 1m2 cubic vessel; KSt = 100 - 140 bar m/s
Most dust will not explode if the dispersion is too rich or too lean, MEC = ~30 - >1000g.m3
Minimum Ignition Energy typical for most hazardous dusts, MIE = 10 30 mJ
Minimum Ignition Temperature MIT = ~250°C relatively low for most industrial dusts, but then wood is been processed to be a fuel.

When designing your Protection system it is important that you are aware of the plant strength, because if the Pred –reduced explosion pressure is greater than your vessel strength then the rupture can have fatal consequences.



**Protection**

ATEX have developed their highly successful Dry chemical system by totally redesigning the release valve itself. Providing a reusable valve lowered the cost of system reconditioning and therefore the total operational cost.

With ATEX you don't have to choose reliability verses false release protection. With ATEX the sensors are programmed in a series type confirmation mode, to prevent false release. If the system determines that the sensor is not responding, it will automatically reprogram itself to a single sensor response providing the higher degree of reliability without compromising the false alarm signal processing.

Bottles and sensors are modular and addressable. You can have one a one zone system with 2 sensors and 1 to 60 bottles or multiple zones depending on the enclosure you require. Each Zone has a log read out in real time of all system activity. You can download the sensor data, with 25% recording the pressure before the actual event from its black box recording sensor head. From one central point you can monitor all the bottles and sensors with an option to connect via modem.