Explosion protection needs and awareness in the biomass industry

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Wood is the largest biomass energy source today; examples include forest residues (such as dead trees, branches and tree stumps), yard clippings, wood chips and even municipal solid waste. Wood energy is derived by using lignocellulosic biomass (second-generation biofuels) as fuel. Harvested wood may be used directly as a fuel or collected from wood waste streams to be processed into pellet fuel or other forms of fuels.

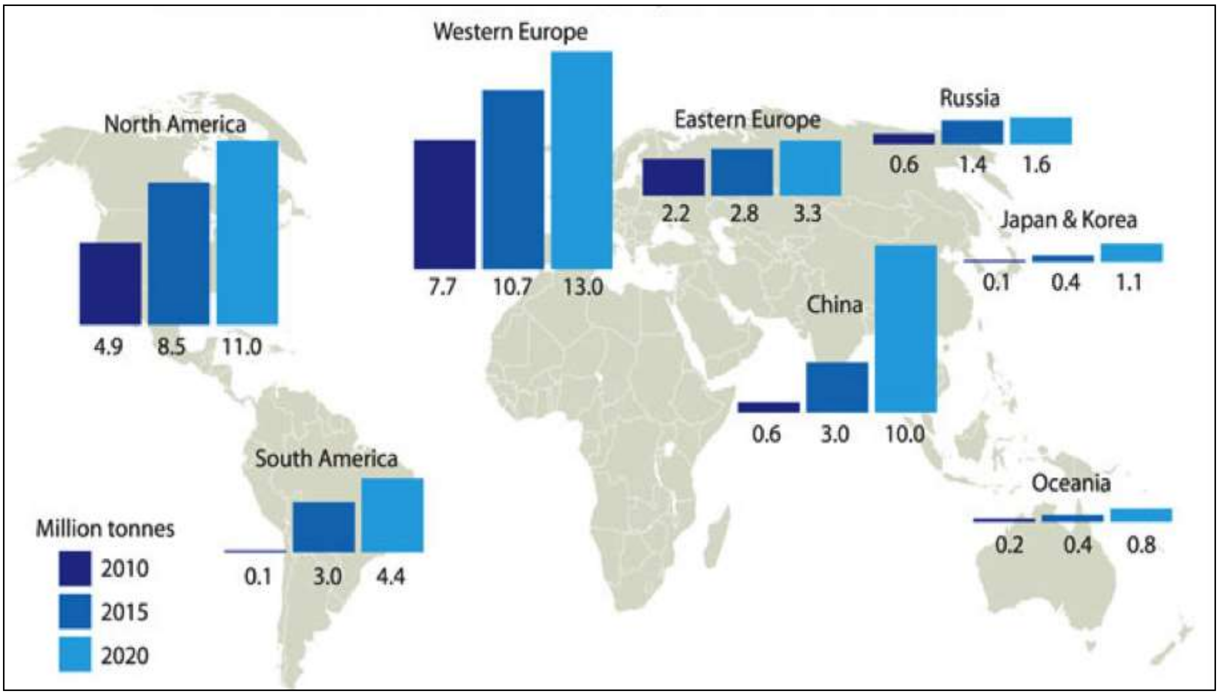


Figure 1: Global pellet production – 2010, 2015 and 2020 Outlook

Biomass power plants rely on biomass availability in close proximity as transport costs of the (bulky) fuel play a key factor in the plant's economics. Rail and especially shipping on waterways can reduce transport costs significantly, which has led to a global biomass market.

The concern with this is that during the processing of wood biomass, wood dust will be produced, which results in fire and explosion hazards. As a general rule, fire and explosion hazards increase with the fineness of the dust particles suspended in air. A dust cloud in air which contains particles finer than 0.5 mm in diameter (-30 Mesh in the figure below) should be assumed to be explosive.

Figure 2: wood pellet particle size distribution samples during processing (from Paul Janzé – Advanced Biomass Consulting Inc. November 2, 2014).

Wood pellets are typically 12×6 mm (BS EN 17225). During transport, these can deteriorate generating up to 10 per cent dust. Other forms of biomass also contain proportions of dust, which can typically occur in pockets within the bulk material.

The increase in use of bulk biomass has resulted in an increased number of fire and explosion incidents. The use of biomass in power generation has led to stockpiling and storage of ever-larger quantities of materials at transfer hubs and power stations. Significant stockpiles are also held by producers of MDF, chipboard and similar materials.

Whilst the term "biomass" sound innocuous, biomass in bulk is a dangerous material which can ignite and burn spontaneously and the dust is explosive. There is a large number of biomass incidents which have resulted in not only the loss of large quantities of materials and damage to plant, but also environmental pollution, injury to personnel and, in a number of cases, loss of life. The list of incidents includes pellet production plants, power stations, storage facilities and MDF production plants.

Unfortunately the fire and explosion risk of biomass remains understated, mainly because the technology of industrialising this biomass is relatively new and most of the efforts are spent on perfecting the production of the pellet and maximising the efficiency of transforming the heat of combustion into work, mostly electrical energy.

The hazards of fire and dust explosions in other organic materials is well-known, and has been extensively researched long before the term "biomass" came into common use. For example, there are examples of dust explosions in flour mills and grain elevators dating back to the 1870s. In the rush to meet environmental "green" targets the industry appears to have forgotten the safety lessons learned previously.

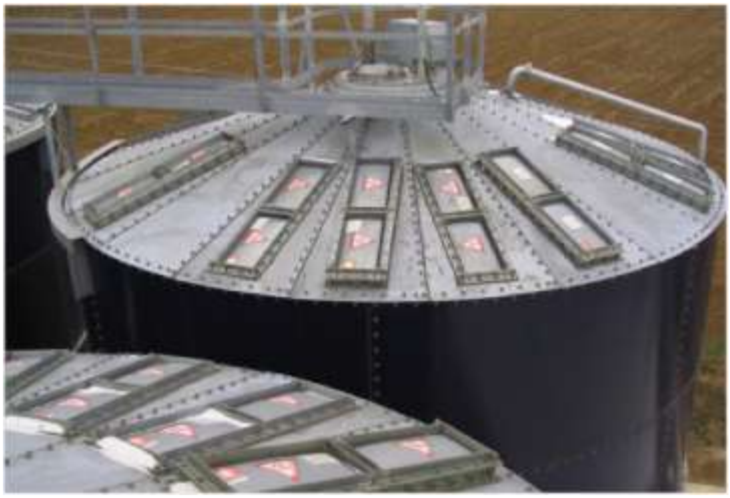
A significant contribution has been made by Staffan Melin, research director of the Wood Pellet Association of Canada. He lists the following common issues in the handling of wood pellets:

- Huge amounts of fines
- Issues of dust emission and control
    - Inhalation of dust and spores (health risk)
    - Prevent fires and secondary explosions
- Best practice
    - Fitting dust containment to open chutes
    - Dust extraction systems
    - Dust monitors
    - Prevent water ingress
    - Wall lining to reduce wall friction, bridging and deposits
    - Dust explosion prevention and protection measures

Staffan makes the following recommendations and reference to guidelines:

- The guidelines documented by NFPA are considered the industry standard. Most spaces in a pellet plant should be classified as Class II Division 1 (see NFPA 499, Chapter 4.1). The wood dust itself is classified as Group G (see NFPA 709, Chapter 500.6). Each area of a manufacturing plant shall be classified in accordance with the Hazardous Zone definitions in NFPA 70, Chapter 506. Most of the production areas of a pellet plant would fall into Zone 20.
- NFPA 68 (Explosion venting)
- NFPA 69 (Explosion Protection)

Strictly speaking, here in Canada all NFPA standards and guidelines are not universally adopted as they are U.S. documents, however as stated above they are an industry standards and are recognised as best engineering practice with respect to explosion protection. Equally as important, the National Fire code and virtually all Provincial Fire codes across Canada reference explosion protection directly as a requirement, and also call upon NFPA 68, and NFPA 69 as the required standards to use when applying explosion protection. Furthermore, each province's occupational health and safety agency and the building department also call for various levels of protection from dust explosion hazards.



Biomass fuels are also susceptible to spontaneous heating and spontaneous combustion. These problems can occur at any stage in their storage, production and transportation. If spontaneous combustion can be detected at an early stage, preventative action can be taken before significant loss or damage can occur.

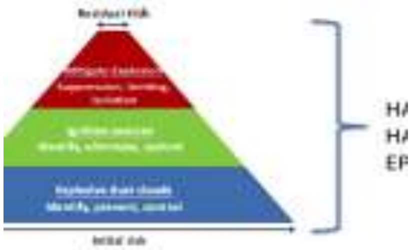
The protection industry offers a full range of detection options for every stage of the combustion process. Available technologies include infrared thermal imaging, infrared line-scanning and carbon monoxide gas detection. The best measurement choice depends on the location and the nature of the risk.

It is important that the monitoring equipment does not itself pose an explosion risk and will therefore need to be supplied with hazardous area approvals.

Biomass has unique hazards which often make it difficult to detect fires at an early stage and, once established, biomass fires offer unique challenges in fire-fighting. The transportation of biomass using conveyors and hopper systems can spread ignition sources very rapidly throughout the facility as the material is moved rapidly. Explosion venting of conveyors and bucket elevators decrease the risk of propagation, however isolation means are required to prevent secondary explosions throughout the plant.








The process of hazard definition and implementation of protection measures is a specialist area and each step requires careful consideration in order to meet an acceptable residual risk.

Fike has worked with end-users, jurisdictional bodies, and consultants throughout the world biomass market, mitigating risk by designing and supplying locally compliant Explosion Protection systems. Fike Canada can be contacted at fikecanada@fike.com

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