Combustible gas: dryer systems hazards and best practices

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Workplaces that manufacture engineered wood products or wood pellets may be at risk of fire, deflagration or explosion due to the buildup of combustible off-gas within dryers and associated drying systems during the process of drying wood fibre.

Why focus on combustible gas safety training today? There have been a number of recent dryer explosions in the wood products industry:

- 100 Mile House, B.C. – 2011
- Burns Lake, B.C. – 2014
- Williams Lake, B.C. – 2017
- Slave Lake, Alberta – 2017
- Entwistle, Alberta – 2018

Baghouses can also be a source of fires and explosions, which happened in Quesnel, B.C. in 2016.

What is combustible gas?

Syngas: According to EnggCyclopedia, "Syngas is a mixture of Carbon Monoxide and Hydrogen which is the product of oxygen gasification of organic material such as biomass. After clean up, syngas can be used to produce organic molecules such as synthetic natural gas (SNG-methane (CH4)) or liquid biofuel such as synthetic diesel. Syngas is the term generally used for a mixture of combustible

gases. So typically a syngas mixture will constitute only of hydrogen and carbon monoxide, with possibility of having carbon dioxide content sometimes. If the gasification product contains significant amount of non-combustible gases such as nitrogen and carbon dioxide, the term used for such mixtures is 'Producer Gas'." The heating value of syngas varies from 11 to 18MJ/m3 depending upon its constituents which is about 10 per cent of the heating value of Propane or Natural gas.

Producer Gas: According to EnggCyclopedia, "Producer gas is a mixture of combustible (Hydrogen, Methane and Carbon Monoxide) and non-combustible (Nitrogen, Carbon dioxide) gases. The heating value of producer gas varies from 4.5 to 6 MJ/m3 depending upon its constituents. Similar to syngas, producer gas is also produced by gasification of carbonaceous material such as coal or biomass. When atmospheric air is used as gasification agent, the producer gas consist mostly of carbon monoxide, hydrogen, nitrogen, carbon dioxide and methane."

Click on the following link to watch a video of a backdraft simulator - www.youtube.com/watch?v=Et_Y_kZXoQQ&feature=youtu.be

[This article is part of Dust Safety Week 2019. To read more articles on dust safety, click here.]

The problem

Combustion gas or syngas producing equipment such as wood dryers are not properly identified as such and there are no current regulations being enforced to design and maintain such equipment to prevent explosions.

Dryers at greatest risk of fire or explosions during these situations:

- Sudden, unexpected power outages and/or power bumps.
- Scheduled maintenance days during shut down process.
- Dryer component equipment failure such as a clogged cyclone, infeed airlock jam, faulty control dampers, etc.
- Faulty fire protection equipment such as plugged or missing deluge nozzles, faulty solenoid valves on extinguishing nozzles, etc.
- Distracted operations, such as when another area of the plant is having issues causing the drying equipment to be shut down too fast.

Dryer fires and explosions most frequently happen in these locations:

- Dryer cyclone inner tube guard

- Ducting between cyclone and ID fan
- Recirculation ducting
- Any place listed above where there is “tramp” air from air leaks
- Dryer vessel itself although rare in rotary dryers due to the deluge process
- Downstream pollution abatement equipment where combustible gases can accumulate

Note: Items listed is where a smouldering process starts often during an upset condition or when a dryer is being shut down. Once dryer ID fan is off or air flow is ramped down, the smouldering material produces combustion gas which can then accumulate over time in all the drying process vessels to dangerous levels.

Dryer maintenance considerations

- Fan cleaning
- Damper cleaning
- Explosion panel maintenance (leaks)
- Thermocouple calibrations (over drying of material)
- Moisture meter calibrations (over drying of material)
- Damper actuator calibration/linkage check.
- Airlock wipe change out (fines carry over)
- Dryer drum internals/flight inspection
- Dryer drum speed calibration
- Dryer substitution load and deluge nozzle check
- New equipment commissioning

Operator training

Operators are key personnel and must be supported by a required and documented training process that is effective. The training must involve both testing and demonstration of abilities. The Wood Pellet Association of Canada, in conjunction with the BC Forest Safety Council, is working on initiating a training curriculum for control room operators.

Fire protection systems

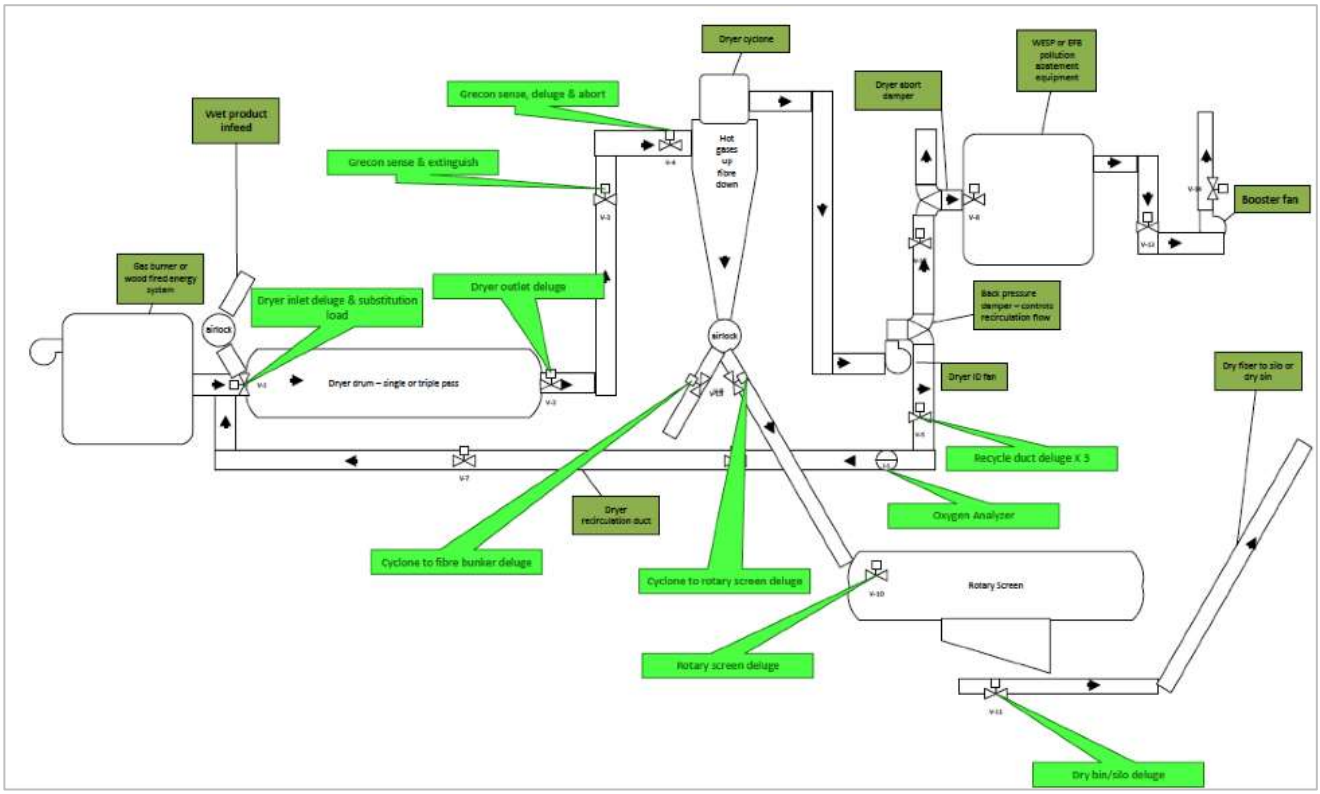
There are a *number of fire protection systems* on the market. One such system is a *spark detection system from GreCon* that detects an ignition source and extinguishes it before sparks or embers reach a dust collection, filter or silo.

Risk and mitigation

There are several forms readily available from the Wood Pellet Association of Canada Safety Committee, BC Forest Safety Council and WorkSafeBC.

- Management of change (MOC)
- Human Computer Interface (HCI)
- Combustible gas risk advisory Safety bulletin
- Risk and mitigation

Process hazard assessments are typically facilitated by third party and must include key stakeholders such as engineers, programmers, managers and operators.



WorkSafeBC has put together a *video outlining potential additional consequences* of a dryer or even baghouse explosion.

Click on the following link to watch the video -
www.youtube.com/watch?v=70fZqHsEdMo&feature=youtu.be

Why do we need to know this?

We are on the cusp of the bioenergy industry skyrocketing. Most industrial equipment that produces syngas or combustible gas have not yet been properly identified and is not being properly regulated to prevent explosions. The public are at risk including people who are close to us.

Regulations:

- NFPA 67 – Guideline on Explosion Protection for Gaseous Mixtures in Pipe Systems.
- NFPA 68 – Standard on Explosion Protection by Deflagration Venting.

NFPA 69 – Standard on Explosion Prevention Systems. (Covers the design, construction, operation, maintenance and testing of systems for the prevention of deflagration explosions by means of the following methods:

a) control of oxidant concentration;
b) control of combustible concentration;
c) explosion suppression;
d) deflagration pressure containment;
e) spark extinguishing systems)

- Qualifications for operators with emphasis on responsibility & accountability. (Similar to a Power Engineer or Mechanical Engineer)
- Insurance companies

Kevin Ericsson with Cariboo Biomass Consultinghas over 34 years of experience in the forest industry including logging, biomass co-generation, plywood, oriented strand board and has worked as a chief engineer for the past 20 years with a 3rd class stationary engineering certification. Kevin has also worked as a Paramedic for BC Ambulance for the past 29 years. Has worked for reputable companies that include Slocan Forest Products, Ainsworth Engineered Canada LP, Nexterra Systems Corp., the University of Northern BC, WorkSafeBC, BC Forest Safety Council, Pinnacle Renewable Energy, Tolko, Deltech Manufacturing and most recently Norbord Inc. Kevin has also been facilitating very popular full day training sessions on syngas awareness in industry to various groups.