New: very early smoke detection line – now with gas detection and environmental monitoring

Ideal for applications in warehouses, manufacturing facilities, battery room, boiler rooms and tunnels (amongst others) is the new VESDA ECO from Xtralis.

Xtralis has taken smoke detection to a new level by expanding its range of VESDA (very early warning smoke detection) aspirating smoke detection systems with gas detection and environmental monitoring. VESDA ECO uses new or existing VESDA pipe networks to reliably detect smoke in addition to hazardous/combustible gases to ensure air quality.

It has been designed to easily integrate with other building management systems to provide real-time situational awareness and intelligent emergency response – and that includes the activation of demand-controlled ventilation.

The system has been launched to tackle head on the fact that invisible hazards can originate from the release of toxic gases, oxygen deficiency, or the presence of combustible gases/vapours.

Xtralis President and CEO Samir Samhouri told IFJ that VESDA users could now fully realise the value of their systems beyond smoke, by also including gas detection and environmental monitoring.

Since the launch of VESDA ECO a few months ago the system has already been deployed in power plants in South America; car parks in Europe; and data centres, national laboratory, wireless telecom facility and historical relic displays in the US.

Benefits of the new system is that the VESDA ECO detectors are installed on the VESDA pipe network; this delivers continuous active air sampling, better area coverage over conventional fixed spot gas detectors, the ability to detect gases in harsh environments by conditioning the air to remove moisture, dirt and other particulates, as well delivering reduced installation and maintenance costs – all advantages over traditional fixed point gas-detection systems.

Each VESDA ECO detector can house up to two gas sensors, and additional detectors can be added easily to the pipe network to monitor more gases if required.

A wide range detectors are available to protect personal and property from combustible, toxic, and oxygen deficient environment. Additional detectors are available that can be used to reduce energy cost when deployed in demand controlled ventilation applications where ventilation only occurs when the gas of interest is present preventing continuous 24/7 ventilation. An example of available gases include; ammonia (NH3), carbon monoxide (CO), hydrogen (H2), hydrogen sulphide (H2S), methane (CH4), nitrogen dioxide (NO2), oxygen (O2), propane (C3H8) and sulphur dioxide (SO2).

Point, zone or total-area coverage can be provided to suit different applications, and the system easily integrates with fire alarm control panels (FACP), programmable logic controllers (PLC), heating ventilation and air conditioning (HVAC) systems, and building management systems (BMS) to provide real-time situational awareness for intelligent emergency response.

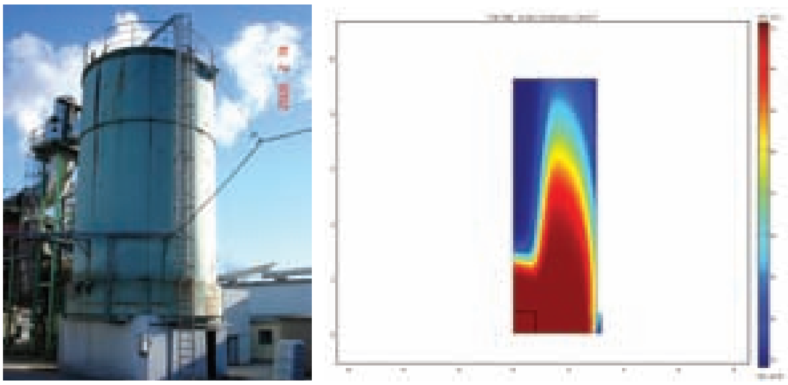

Figure 4, left: the 300 m^3 test silo used for the gas distribution tests. Right: simulated nitrogen distribution inside the test silo assuming a higher amount of fine fraction in the silo centre and an injection rate of 4.5kg/m^{2}h. Red colour – 100 % N$_2$, blue colour – air (21% O$_2$). The silo centre and the gas inlet are located in the lower left corner of the figure.

flow rate, the location of the inlet and the properties of the bulk. At a low flow rate (about 1.0 kg/m^2 h), the radial gas distribution was limited and an effective inerting of the material was only obtained in a part of the silo cross section. Using a higher gas flow rate (about 4.5 kg/m^2 h), the radial distribution was improved. It was also observed that the bulk had a lower permeability in the silo centre due to a higher amount of fine fraction which had a significant influence on the gas distribution.

As a complement to the gas filling tests, mathematical simulations of the gas distribution inside a silo were also made. Some of the simulations carried out were intended to give an idea of the expected gas distribution in the test silo (see Figure 4), and others to study the gas distribution in very large silos under a variety of conditions. The simulations assumed axi-symmetry conditions which means that only one half of the silo was simulated. The main conclusion from the tests and simulations is that several inlets are recommended if the silo diameter exceeds 6-8m.

Experience from real fire incidents

The results from the first silo project were successfully applied to a real silo fire in 2007 in Sweden[7]. Auto-ignition occurred in a silo, 47m high and 8m in diameter, filled to about 40m with wood pellets, see Figure 5. Elevated temperatures had been noted for some period of time and it was planned to empty the silo within the next few days. However, before such action was

Figure 5: the silo on fire (second from right) was 47m high, 8 m in diameter, and filled to about 40m with wood pellets. A vaporisation unit was used to ensure that the gas was injected in gaseous phase.

taken, smoke was seem emerging from the top of the silo and the fire brigade was called to the location. A first extinguishing attempt was made using the application of CO_2 in liquid phase to the top volume of the silo. During approx 18h, about 35 tons of CO_2 was applied intermittently. The application seemed to control the fire but there were no possibilities to verify how much of the gas was penetrating into the bulk material and how much was lost immediately through the opening in the top of the silo. Consequently, it was not possible to make any judgment of the extinguishing effect and when a discharge operation could be safely started.

Preparations were therefore made to inject nitrogen close to the silo bottom according to the recommendations from the silo experiments in 2006[5]. A gas tank with liquefied nitrogen and a vaporization unit was ordered. A hole was drilled close to the bottom of the silo and an injection probe was manufactured which was introduced into the hole. In order to control the effect of the gas injection, temperatures and concentrations of CO, CO_2 and O_2 were measured in the top of the silo.

The gas measurements were started just before commencement of nitrogen injection and showed a very high concentration of CO(>10%), verifying an ongoing pyrolysis activity. About 3.5 hours after start of gas injection, the first indication of a decreasing CO concentration was seen. After about 18h, the CO-concentration had been reduced to about 2% and the O2-concentration was 0%. At this point it was decided to begin discharge of the silo in combination with a continuous injection of nitrogen. The unloading work continued for about 48 hours but had to be stopped on several occasions for safety reasons due to high temperatures and increasing oxygen concentration in the top of the silo. This was probably due to the fact that the seat of the fire became exposed on these occasions. In total, nitrogen injection continued for almost 65 hours without interruption, with approximately 14 ton of nitrogen used, corresponding to an average injection rate of about 4 kg/m^2h. The gross volume of the silo was about 2500m^3 which gives a total gas consumption of approximately 5.6 kg/m^3 which is well in line with the recommendations from the research project[5].

Summarized guidelines

Below is a very brief summary of the recommended measures to be taken in case of a silo fire:

- Make an initial risk assessment of the situation. There might be very high levels of carbon monoxide in indoor areas in the vicinity of the silo. Further, consider the risk for dust and gas explosions in the silo and in any connected conveyer belt systems.
- Close all openings of the silo and turn off ventilation so that air entrainment into the silo is minimized. However, there must be a released hatch or similar in the silo top for gas and pressure relief while still preventing any inflow of air.
- Inject nitrogen close to the bottom of the silo. The nitrogen should be injected in gaseous phase, and an evaporator must be used. Assume an injection rate of 5 kg/m^2 hour (cross sectional area) and a total gas consumption of 5-15 kg/m^3 (gross volume) of the silo.
- If possible, measure the concentration of CO and O_2 at the top of the silo during the entire extinguishing and discharge operation.
- Do not start discharging the silo until there are clear signs (low levels of CO and O_2) that the fire is under control.
- Be aware of that the discharge capacity might be considerably reduced compared to a normal situation and that the discharge operation might take several days to complete.
- The discharged pellets must be inspected for glowing or burning material and extinguished with water if necessary.
- The gas injection should continue during the entire discharge process.

Important to remember!

- Do not open the silo during the firefighting operation. This will cause air entrainment which will increase the fire intensity and might cause dust and gas explosions and a severe fire situation.
- Do not use water inside a silo filled with wood pellets. Water application will cause considerable swelling (see figure 6) of the pellets which could both damage the silo construction and cause significant problems for the discharge operation.

Conclusions

Renewable fuels are an important issue both nationally and internationally. Clearly there are risks associated with large changes in the use and handling of new fuels or even old fuels in new applications. The use of solid fuels, such as wood pellets produced from low grade wood material not suitable for more refined uses, is increasing with no visible decline foreseen in the near future. Risks associated with their storage have been investigated in the two studies presented in this paper and a set of recommendations defined to assist in the efficient and safe extinguishment of storage facilities should spontaneous ignition occur. These recommendations have been successfully applied to a number of real fires and should provide a sound basis for the design of future facilities or retrofit of existing facilities to enable their rapid application in the event of a fire.

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