CASE STUDY

Innovative Spark Detection And Extinguishing Solution for Biomass Steam Power Plant

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When a major European distiller invested in a modern Bio-Energy steam power plant for their facility located in Western Finland, they turned to Atexon® Oy, the innovative specialists in spark detection and extinguishing systems to provide a fully integrated solution to detect ignition sources from hot particles within the new plant with the aim of eliminating or mitigating the costly consequences of any resulting fires or explosions within the material handling and process lines.

The end product from the distillery is high quality grain alcohol distilled from Finnish barley for use in many famous international drinks brands. Annual production stands at around 30 million litres of 96% grain alcohol using a 250-fold distillation process. The same barley is also made into starch, fodder and carbon dioxide.

Prior to the new Bio-Energy plant, steam was generated using traditional fuels such as milled peat, however, the company recognised the benefits of switching to a more sustainable multi-fuel solution. This was chiefly field biomass (barley husk, grain particles and straw) as well as fusel oils, woodchip and peat, leading to greater fuel self- sufficiency and significantly reducing their overall carbon footprint, at the same time as improving operational cost effectiveness. The plant subsequently became the first steam boiler plant in Finland capable of running solely on field biomass. The plant was developed in cooperation with a specialist Finnish engineering company who carried out the overall plant design and construction and who are also responsible for its ongoing operation and maintenance.

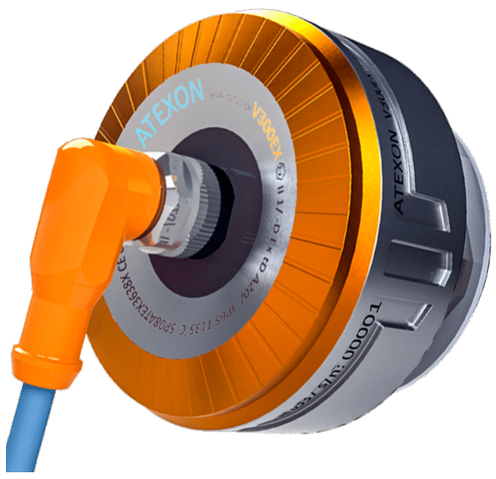
In view of the combustible nature of the biofuels in use, it was essential to safeguard the plant against the potentially disastrous effects of dust explosions, fire accidents and overheating of components that could lead to production down-time, machine failures and property losses, at the same time as enhancing safety for the employees and protection of the wider environment. Such fires and explosions could arise from a variety of ignition sources such as mechanical failure, entrained abrasive material, frictional heat generation, static electricity, impurities within the process material as well as self-ignition (chemical reaction or microbiological decay). To address these ever-present ignition risks, Atexon® were consulted at an early stage to propose an overall solution to monitor the process lines within the three main areas of the plant – the fuel receiving station, the screening station and the boiler house, as well as two fuel storage silos.

Atexon®'s origins date back to the year 2000 and the company was founded with the aim of helping industry reduce the risk of fires and explosions in many different processes. The company is now internationally recognized through innovative technologies for suppressing ignition sources within combustible dust areas by advanced early spark detection and rapid acting extinguishing systems, as well as monitoring surface temperature and flame detection. Atexon® is based in the Oulu region of Northern Finland which is a well-known centre of excellence for research and development in electronics, and this has helped facilitate the design of unique and patented spark detection technologies.

Owing to the wide range of fuels used in the new plant and the specialized nature of the processing and material handling equipment involved, several technical challenges had to be overcome requiring several types of detection, monitoring and control methods.

Perhaps the most important technical challenge in monitoring the plant was the selection and location of the spark detectors that would be needed to activate the extinguishing system if an ignition source (spark, hot particle or ember) was detected in the process material (fuel).

Conventional spark detection of materials moving inside closed de-dusting/dust extraction systems is a well-established method. Sensors typically operating in the Near Infra-Red (NIR) range offer good sensitivity to sparks through multiple material layers, although they cannot detect hot particles at high temperatures. Alternatively, sensors operating in the Infra-Red (IR) range can detect hot particles (250-400°C) but have poor sensitivity through material layers.



Using advanced electronics, Atexon®'s patented and ATEX compliant V300EX detector operates both in the NIR and IR range to offer a wide detection spectrum for all types of hot particle ignition sources, whether they emit visible or invisible light. Furthermore, the V300EX has an extra wide field of view (up to 180°) when compared to conventional sensors (up to 110°) leading to a fourfold increase in sensitivity when installed in ducting or chutes, providing a major reduction in "blind spots".

Another important consideration for reliable spark detection in the plant was the fact that at certain stages of the process, the material was being handled in an open area in the presence of daylight – for example in the receiving station. Conventional spark detectors would be compromised by the presence of daylight, however the V300EX incorporates daylight filtering technology making it suited to installations in difficult situations such as this. Spark detectors were also installed in the dedusting lines connected to the silos, and as these were positioned in a difficult to access elevated location (25 metres high), VMR200EX units were specified to incorporate remote "clean window testing" to enable remote sensor monitoring to facilitate easier maintenance.

In the event of a positive detection of a spark or hot particle, the extinguishing system reacts very rapidly (typically 0.05-0.1 seconds) and introduces a carefully measured amount of water (between 5-30 litres per event). The extinguishing system includes a pressure boosting station with membrane tanks to eliminate any air bubbles from the water. A high pressure system allows the generation of small droplet sizes, enhancing the extinguishing performance and reducing any negative effects on production from excessive water application. In view of the northerly location of the plant, any external/exposed water piping was heat traced and insulated to prevent freezing and ensure the water is kept at the optimum temperature.

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In addition to detection of sparks and other ignition sources in the process material, it was important to ensure that in the event of an activation and discharge of the extinguishing system, there could be no contamination of the process material (fuel), and the plant could go back on line with minimum interruption. To meet this challenge, a fast-acting diverter valve was installed in the chute leading to the fine screening station in the boiler house to route any fuel contaminated by extinguishant (water) after activation away to a collecting container. This also provided an additional benefit in the way that the contents of the container could be analyzed after an activation to determine the cause of ignition (for example, abrasive material or foreign objects introduced at the receiving station).

The plant was designed with the aim of “zero wastage” and therefore any dust settling on the surfaces of the plant production area is routinely collected via a vacuum system and returned to the plant as part of the fuel mix. Similarly, fusel oil from the distillation process is also incorporated in the boiler fuel, and this gives rise to an additional need to detect any leakage at an early stage in the open area around the burner. To address this challenge Atexon® supplied flame detectors and a pressurized water misting extinguishing system to create a “cube of water mist” envelope around the burner in the event of any external flame development. Detection of sparks is not usually possible inside silos where there is a dense concentration of bulk material, however Atexon® included Carbon Monoxide monitoring on top of the silos to detect the result of any burning material inside the silo at an early stage.

All the various elements of the Atexon® solution for the process lines within the Plant – spark and flame detection, carbon monoxide monitoring and extinguishing system - were linked back to an Atexon® VR18Z control panel, with a common user interface and emergency battery backup with local alarms and plant/process shut down capability.

How a Spark Detection and Extinguishing System Works

Dust Extraction System Protection

- Ignition sources are traveling to dust collector
- Spark detectors (1) detect ignition sources
- System control unit receives signal detector, activates water extinguisher (2)
- Water is sprayed from nozzles into dust pipe typically 5 seconds after spark
- The Fan Controller (6) stops the fan in case of fan overheating or spark shower
- The overheat sensing cable monitors the fan bearing and the fan perimeter
- The pressure booster controller (8) control the water pump and the heat tracing cables
- The pressure booster (9) ensures airless extinguishing water with correct pressure

The new 10MW steam energy plant, the first in Finland to be able to run entirely on field biomass, is now fully operational and produces enough steam for all production processes, as well as supplying compressed air for the processes and operating the water and wastewater treatment works. Overall plant and process safety through early stage ignition detection and monitoring is enhanced through the fully integrated system designed, installed and maintained by Atexon® Oy.

The technical challenges that needed to be overcome to complete this ground-breaking project strongly illustrate the specialist expertise and innovative solutions offered by Atexon® Oy, comprising engineering review and design, system supply, installation and ongoing maintenance, training and support. Atexon® Oy, Oulunsalo, Finland is part of the global IEP Technologies/HOERBIGER Safety Solutions network, with local sales, service and support centres throughout Europe as well as North America, Latin America, Middle East/Africa and Asia/Pacific.

To learn more about Atexon® Spark Detection and Extinguishing Systems, as well as the specialised range of Industrial Explosion Protection products and services offered by IEP Technologies, or simply to find your local sales, service and support centre visit www. IEPTechnologies.com or contact +1-855-793-8407.

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