TWO YEARS EXPERIENCE WITH THE 100,000 M3 EUROSILOS!

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Introduction

An enclosed storage system had to be integrated into the high (safety) requirements of the new power plant, i.e. in the field of protection against fire and explosions. The safe control and trouble-free operation philosophy had to be followed. The coal storage plant is introduced here, as well as the results of the nitrogen (N_2) purging equipment and the operating experiences.

The Trianel Coal Fired Power Plant in Lünen, Germany, is home to the largest coal silo storage facility in Europe, containing 100,000 m^3 per silo.

The Lünen coal-fired power plant lies approximately 15km north of Dortmund in North-Rhine Westphalia region and is a 750MW hard coal-fired power plant. With a net efficiency of approximately 46%, the plant is the most efficient and cleanest coal-fired power plant in Europe.

Permission for the construction and operation of the Lünen power plant was received in May 2008 and construction began in September 2008. First power was transferred to the grid in December 2013.

The power plant is estimated to use approximately 240t of coal per hour at full load. Coal is sourced through long-term coal supply contracts and delivered via the Datteln-Hamm Canal.

Eurosilo was awarded the contract for constructing the coal storage silos for the plant.

Figure 1 overview of the Lünen Coal Fired Power Plant.

Coal Handling

The plant requires about 2 million tons of coal per year. The coal is sourced from various mining regions around the world and delivered to the port of Rotterdam by bulk carriers. From there, it is loaded onto barges (typically four per day) and delivered to the plant.

The coal is unloaded using cranes at the plant-owned port and is stored dust-free in two silos with a 200,000-ton total capacity—enough to operate the plant for about 30 days at full load. Fugitive dust emissions are virtually eliminated through the use of fully enclosed conveyor systems.

Figure 2 One of the 2 Ship Unloading Cranes

A possibility is to convey coal directly from the cranes via a by-pass to the four day bunkers were it can be burned the same day in the boiler.

The coal is conveyed from the silos to four day bunkers that can hold 800 tons each in the steam generator building. It is then pulverized and fed into Lünen's 70-m-tall boiler.

Coal can be, in case of emergency, conveyed from the Eurosilos to an emergency load-out area, where it can be treated and e.g. afterwards transported to be re-used.

ESI Eurosilo has carried out the maintenance and inspections for the first 2 years of Eurosilos operation.

By this experience and insight was gained in daily operations of coal silos in general and of the Lünen installation in detail. This enabled all parties to gain and share experiences and optimise the daily use, operation, maintenance and inspections of the Eurosilos. Building a close cooperation between parties and enabling the maintaining of high standards of working and the implementation of ideas together.

Coal Silos going into Details

Why Eurosilos?

Summary of comparisons between options for enclosed storage systems for the coal:

	Eurosilo	Circular (Dome) storage	Longitudinal (A-frame) storage
Footprint	The most compact system	2 x larger footprint	3 x larger footprint
Filling (infeed)	Minimal segregation by equalizing auger	Segregation	Segregation
Operation	Fully automated	Partly automated	Partly automated
Oxygen access	Limited	Severe	Severe
Nitrogen purging	Possible through bottom piping	Not possible	Not possible
Structure	Simple slip form	Complex concrete wall	Standard A-frame shed
Coal monitoring	Continuous monitoring by CO	Only by infrared	Only by infrared
Fuel Manage-ment	Fully automated	Partly automated	Partly automated
Dust emission	NO	NO	NO
Percolation pollution	NO	NO	NO

Figure 3 Table of comparison of systems

Eurosilo Advantages

Summary of the decisive Eurosilo advantages for the Lünen Coal fired Power Plant:

- Totally enclosed storage
- State-of-the-Art Technology
- Small footprint
- Fully automated system
- Meeting the most stringent environmental protection requirements (avoids emissions of respirable dust)
- Coal blending (the values of the process parameters and the boiler efficiency depend on the mixture of coal being burnt in the boiler)
- Lower Total Cost of Ownership in comparison to other comparable systems

Blending of Coal

Fuel cost reductions are achieved by delivering coal of a predetermined quality to the burners at all times. If a power plant adopts a dynamic approach to coal blending (i.e., the as-fired blends change continuously to adjust to changing conditions such as load, emissions, capacity, coal availability, and expected coal deliveries), the power plant can reduce fuel-related costs significantly.

Thus operational flexibility is a core requirement for cost-effective power plant operation. To keep emissions of the power plant low and to keep an optimal boiler handling, the mixture of the coal has to be optimal, this is achieved by blending, keeping the ratio from the 2 silos in a predetermined rate.

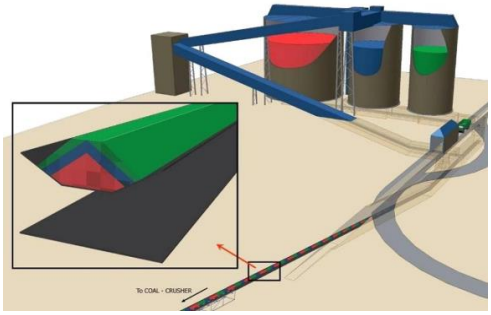

Figure 4 Coal Blending with Eurosilos

Coal: Monitoring, Measuring, Managing

Fundamentals for Monitoring

Upon the arrival of the coal the temperature of the coal in vessel is measured by Temperature Lance and Infrared Camera.

Methane, carbon monoxide and oxygen sensors are present in the basement and at the overhead bridge. Depending on the amount of CO (ppm), monitoring can be intensified and/or preventive actions can be taken.

Monitoring

Measuring carbon monoxide is strongly preferred as detection method for self-heating in coal storage piles due to its more advanced warning period over temperature.

Sensors continuously observe the amount of methane, carbon monoxide and oxygen in the air. Potential hot spots will develop close to the surface.

Figure 5 Positioning the Sensors

Fuel Management System (FMS)

The main goal for a power plant is make sure that the most economic coal of precisely the right quality gets to the burners to meet the boiler requirements. The ability to deliver the right coals to the burners consistently can reduce fuel costs for the plant significantly. For intelligent optimization of coal burning to meet demanding power loads, emission requirements, and cost objectives, it is of eminent importance to know which coal is being burned.

To achieve this goal, a power plant must address three main issues. The first is to know the quality of all the coals purchased and were it is located. The second key issue, operational in nature, is for the power plant to keep track of all coals as they arrive and were they are in the coal silos. The third key issue is the ability to know what coals are being loaded into the day bunker when and in what quantity.

For this ESI delivered the Fuel Management System (FMS).

This software package offers two operate modes:

- Replay mode: display what happened over the past 10 days.
- Monitoring mode: display the current status.

With this the flow of coal in silos and day bunkers can be accurately modelled, the tracking of all coals on site, from receipt to combustion, becomes relatively easy. In addition, the same capability can also be used to perform controlled loading sequences into the day bunkers to assure that coal of a pre-described quality is discharged at pre-described times.

The typical manner in which recommendations are presented to the main control room is in Sulphur content of the coal to the expected load demand over the next period of e.g. 24 hours. The normal operational constraint is that the plant only loads coal into day bunker twice a day.

Settings and Warnings

Upon entering the silo one can easily see if a warning or alarm value is measured inside the silo by the monitoring system. These values are pre-set and are depending on the coal quality.

Figure 6 Warning Signs at the entrance of the silo

Safety Measures

Besides continuous monitoring, active airflow prevention is also part of the Eurosilo® fire system. The hoppers in the bottom of the silo are a potential entry point for air. By installing a slide valve underneath the reclaiming openings, air penetration is reduced to a minimum.

Both Eurosilos are equipped with a Nitrogen-purging system, enabling operators to purge the whole silo, thus enabling longer trouble-free storage periods. The piping for this system is embedded in a layer of gravel at the bottom of the silo and covers the whole surface. It is also connected to the piping in the reclaiming hoppers. Trucks loaded with liquid nitrogen, can be connected to a nitrogen evaporator outside the silo, thus enabling purging the system with nitrogen. This system has proven to be very effective.

Alternatively, the reclaiming hoppers, being a potential entry point for air, can also be purged with nitrogen separately. This can be done by using bottles thus being able to purge small amounts in the hopper.

At the upper bridge level, foam sprayers are present to cover specific parts of the coal surface with a layer of foam in case of a self-heating emergency.

Figure 7 Foam Thrower in top of silo

A spraying system is installed above the heat resistant conveyor belt in the basement of the silo to cool down heated coal.

Figure 8 Spraying the Belt Conveyor under Silos

In the unusual case methane is measured, the ventilation system (2 pcs 50,000 m3/h ventilators) is automatically started. The Eurosilo should then be taken out of operation and a power shutdown in this silo should be organised. Up to this day, this has never occurred.

Hot Spots measurements

Once an increase in CO is measured, one can use the indicative screen in the silos to determine where the hotspot is. For this a control screen displays the approximate position. Then, with a thermal imaging camera one can define the position.

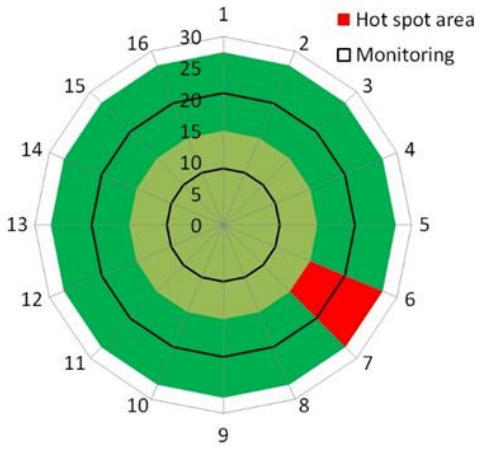

Figure 9 Determining the position of the Hot Spot

Figure 10 Thermal Imaging Camera

Description of FIRESORB-System

FIRESORB® is a fire-fighting device-additive for the firegrade class A. The liquid polymer - solution absorbs a multiple amount of its own weight in water and forms an adhesive and heat-shielding gel which contains no air bubbles but consists of evenly thickened water.

With the FireSorb-system hotspots can be treated. It is only used in small quantities and only to counter the hotspot as it reduces the calorific value of all coal. It can be used from the rotating bridge once the position has been determined.

Experiences with Hot Spots

Running the installation in full operation now since July 2012, experience has been gained with the handling and storing of coal and how to react when possible challenges arise.

The biggest gain in experience has been that there is ample time to evaluate and if a hotspot occurs, it is not necessary to escalate the situation directly to were the firefighting department is handling the situation.

Hotspots can be safely managed and operation of the system is secure and safe.

Picture 11 Fire Fighters with Thermal Imaging Camera monitoring Hotspot Oct 2012

Hotspots are quickly detected by the systems and actions described previously. A decision on how to counter it, is made in accordance with an emergency guidebook. To prevent further damages, hotspots are removed from the Eurosilo, either by hand, by discharge system to emergency load-out or directly in the day bunkers.

Conclusion

Up till now the operating experience with the Eurosilo system for storing both coal and FGD-Gypsum are satisfactory and fulfil the expectations.

For further information please contact us.

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