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REEL MÖLLER®
Wood pellet pneumatic conveying

Wood pellet pneumatic conveying line for RWE Eemshaven

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In August 2017, RWE contracted REEL Möller GmbH to carry out engineering, supply, installation, supervision and commissioning of the first two 100 t/h conveying lines.

Up to 0.8 million tons of wood pellets will be transported on each line every year in order to achieve RWE's environmental targets and cut CO_2 emissions.

This is an ambitious project for a number of reasons, not least because this is the first wood pellet conveying line to cover the necessary conveying capacities over these distances and under ATEX restrictions. Operating at this conveying capacity safely and reliably is a unique challenge.

REEL Möller has installed two new 100 t/h pneumatic conveying lines at the RWE Eemshaven power plant. These are the world's longest pneumatic conveying lines for up to 100 t/h wood pellets.

The Netherlands has very ambitious sustainability goals: a 25% reduction in greenhouse gases by the end of 2020, 40% by 2030 and 95% by 2050. Key to achieving this is the substitution of fossil fuels with carbon neutral energy sources such as biomass. For the state-of-the-art RWE Eemshaven power plant, this means cutting its use of coal and replacing it with up to 40 % wood pellets in two construction phases. The first of these, which will achieve 20 % coal substitution, is currently underway.

Wood pellet handling

Switching fuels has implications across the power plant flow sheet. Wood pellets require different handling and safety measures than coal. They are very coarse compared to mineral bulk materials, a different, more uniform shape, abrasive and, of course, highly combustible and, for the wood pellet fines fractions, explosive.

Pneumatic conveying of wood pellets is challenging. They cannot be fluidised and the air permeability is extremely high, meaning that the air retention is very much reduced. The system needs large quantities of conveying air moving at high speeds to push the wood pellets through the conveying pipe, which naturally presents issues with abrasion, especially at the bends.

System overview

The wood pellets arrive at Eemshaven by ship (max. 8000 DWT) and are unloaded to site by a pneumatic ship unloader. From the docks, the pellets are conveyed to a 12,000 m³ storage silo. Two pneumatic conveying systems are installed beneath the storage silo to transport the wood pellets to the two identical 800 MWe power plant blocks A and B.

CASE STORY

The silo, MÖLLER® conveying system and all associated auxiliary units are subject to the EU Directives on explosion protection (ATEX 2014/34/EU and ATEX 1999/92/EC).

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Silo discharge

Wood pellets fall from the upper rotary vane feeder to the lower rotary vane feeder, facilitating a spark detection system that wouldn't work in a slow-moving wood pellet column. The rotary vane feeders then feed material through to the DN 300/350/400 conveying pipes.

The rotary feeders are designed to withstand the wear created by the line pressure of up to 1.5 bar. To allow conveying outputs to vary in line with demand, the upper rotary vane feeder is equipped with a frequency-controlled geared motor. The lower rotary vane feeder operates at a fixed speed and acts as a pressure barrier.

Silo discharge

The silo has a vibrating floor to facilitate smooth and easy discharge. Beneath the silo floor are four discharge hoppers per line, which work in pairs to collect the wood pellets: two in operation and two ready to take over in case of a blockage or should one of the operating hoppers fall empty. The hoppers discharge the wood pellets to an arrangement of rotary vane feeders: one upper and one lower per hopper.

Each of these rotary vane feeders is designed for a throughput up to 60 t/h (96 m³/h) or a maximum 100 t/h per line (e.g. 60 t/h from one discharge point and 40 t/h from the other).

BIOMASS

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CASE
STORY

Silo discharge and conveying pipe system

Pneumatic conveying

Screw compressors located beneath the silo provide the conveying air for the two pneumatic conveying systems There are two 400 kW screw compressors for each line, each with an aftercooler. A fifth identical screw compressor serves as a shared standby unit. Each of the conveying systems has the capacity to transport 14 – 100 t/h (approximately 22.4 – 160 m³/ h) of wood pellets from the storage silo to an intermediate container of ~60 m³.

For the Block A line this is a distance of 370 m, while for Block B it is 460 m. From the intermediate container, the wood pellets are conveyed to the mill bunkers using discharge and screw conveyors as well as weighing equipment. Here, the wood pellets entering the coal mills, which have been modified for the new fuel.

Safety first

Both RWE and Möller understand the risks involved in transporting fuels – and especially the dangers of wood pellet dust. Risk isn't just about engineering, it's about people. Knowing what's at stake and factoring that into the design is a fundamental part of every project we undertake.

For this project, we dedicated substantial resources to securing the necessary fire/explosion protection equipment during the order execution and commissioning phase. The complete conveying system uses numerous strategies to prevent or limit hazardous explosive atmospheres, ignition sources and potential explosions. For example, the drop chutes between the upper and lower rotary vane feeders and in the screw conveyor are used for timely spark detection.

Six bursting discs are installed per intermediate container in addition to the obligatory silo filter with fan and blow-off silencer. In addition to the temperature, the oxygen (O_2) and carbon monoxide (CO) concentrations are continuously measured and monitored at several points in the intermediate container.

In the event that the temperature, CO and O_2 concentrations exceed or fall below the limit values, the intermediate container can be inerted with nitrogen.

Flow control

Each intermediate container is fitted with a radar sensor for continuous level monitoring. The minimum and maximum level are detected and monitored by means of level switches. A discharge conveyor with a frequency-controlled geared motor discharges material from the intermediate container. The second screw conveyor installed in the conveying system feeds an impact weigher, which helps to determine the mass flow. A rotary vane feeder with leakage gas discharge is installed in order to protect the impact weigher from overpressure from the coal and wood pellet mill, thus preventing bridging or blockages occurring and preventing the wood chips from reaching the mill.

Protection from wear

The wood pellets are classed as abrasive and could cause significant wear to the conveying pipe, especially at the bends. To minimise material abrasion and the risk of blockages during conveying, the conveying pipe piece bends have radii R ≥ 10xD (pipe diameter). Abrasion also occurs to the wood pellets themselves during the materials handling process. But for this application, attrition can be a good thing as it reduces power consumption in the mill. Wood pellet dust is highly explosive, though, so all the aforementioned precautions are necessary.

Commissioning and beyond

Following commissioning, there will be a one-year trial operation period, after which we'll be able to share more details of RWE's operating experiences. The second expansion stage will follow in due course, enabling RWE to achieve its goal of 40 % coal substitution at the Eemshaven plant.

Boiler house and intermediate silo

CASE
STORY

www.reel-moeller.com

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REEL Möller GmbH
Haderslebener Strasse 7
25421 Pinneberg
Germany
Tel.: +49 4101 788-0
Fax: +49 4101 788-140
info@reel-moeller.com
www.reel-moeller.com