DP CleanTech

Creating value from waste

Advanced wood-fired CHP power plant

Siauliai Lithuania

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Introduction

Axis Industries is an EPC supplier from Lithuania and the largest group of companies in Lithuania dealing with industrial and energy sector projects. Axis Industries have been contracted by Šiauliu Energija to deliver, on a turnkey basis, an extension and exchange of an existing fossil fuel power plant in Siauliai.

Axis Industries had little prior experience with biomass thermal plants so DP CleanTech's expertise was required to deliver the complete boiler island, including specialized fuel feeding and combustion systems.

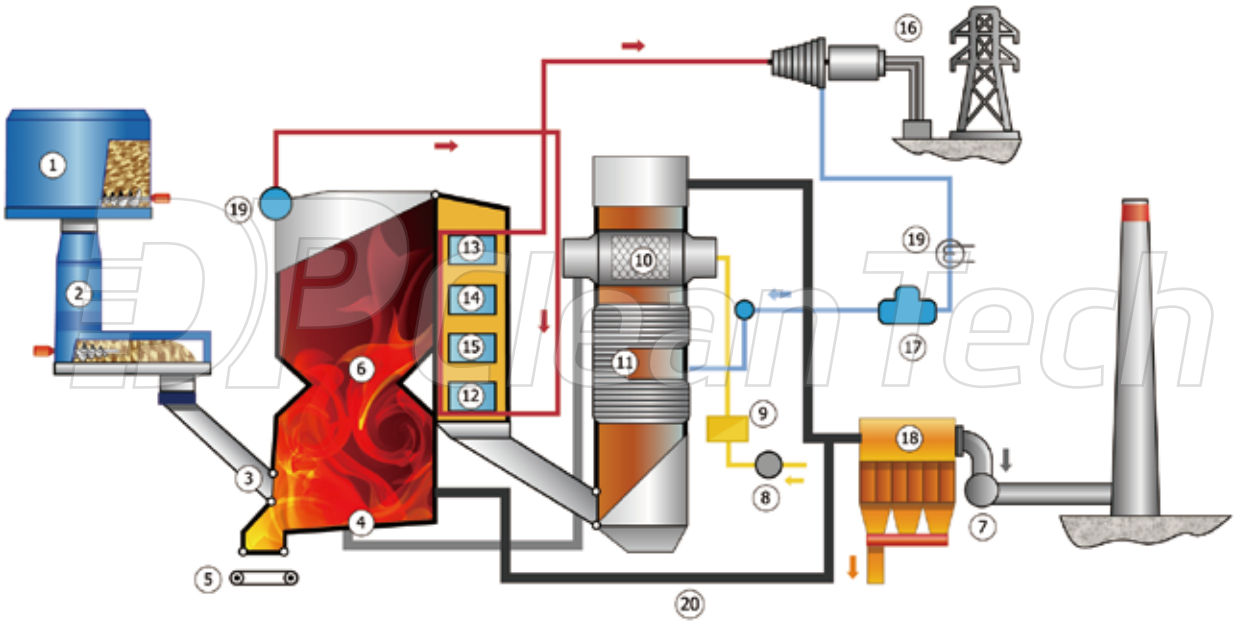
Plant Performance

This biomass-fired CHP plant produces 9.8 MWe net which supplies electricity to approximately 30,000 households. The plant also produces 37 MW of district heating (including condensing economizer) which covers 45 % of the cities heating requirements. The fully automated plant consist of a fuel handling system, a biomass-fired steam boiler, ESP (electrostatic participator) flue gas cleaning system, a flue gas condenser for condensation heat recovery and a steam turbine for electricity production.

The biomass-fired steam boiler operates with steam parameters of 45 bar and 460°C resulting in a net overall plant efficiency of more than 82 % without flue gas condensation and 101% with flue gas condensation. The Flue Gas Cleaning system significantly reduces harmful gases like sulphur dioxide (SO_2) and nitrogen oxide (NOx). Carbon dioxide (CO_2) emissions are reduced by as much as 57000 tons per year.

Fuel	Wood chips
Alternative fuel	30 % peat or 30 % natural gas
Fuel consumption	21.6 t/h
Power output (Net)	9.8 MWe
Thermal output (District heating)	40 MWth
Steam flow	50tph
Steam temperature	460°C
Steam pressure	45 bar
Boiler efficiency	>87%
Plant efficiency	>101%

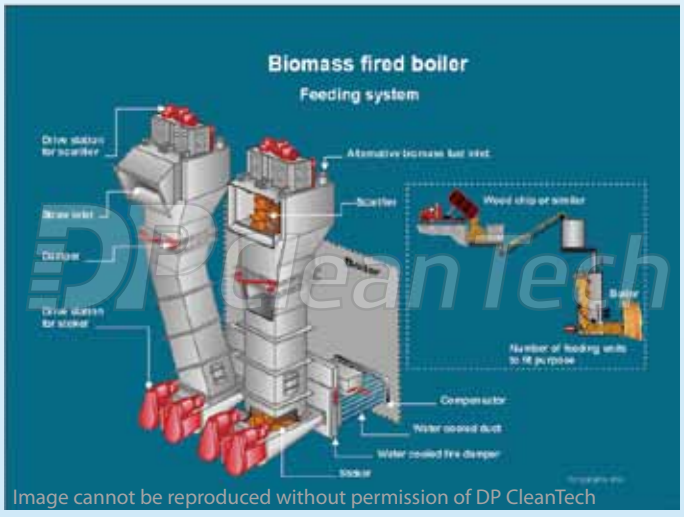
Wood-Fired Boiler



1. Wood chip silo
2. Dosing silo
3. Spreader
4. Vibrating grate
5. Slag conveyor
6. Combustion chamber
7. Induced draught fan
8. Forced draught fan
9. Steam air preheater
10. Air preheater
11. Economiser
12. Evaporator
13. Superheater 3
14. Superheater 2
15. Superheater 1
16. Steam turbine with generator
17. Feed water tank
18. Boiler drum
19. Condenser
20. Ash reburning

Fuel Handling

The plant and specialized feeding system is designed to handle 100 % wood chip or a combination of up to 30 % peat and 70 % wood chip. The plant consumes approximately 102,000 tons of wood chips per year at an average 50% moisture content. The fuel comes from waste residues generated by the logging industry in Lithuania and neighboring countries like Latvia and Belarus. The biomass fuel will be delivered by trucks where it is sorted and stored for up to 5 days. From here it is delivered directly to the dosing silo (buffer silo). The dosing silo has a capacity of approximately one hour operation. From the silo, the fuel is led to the spreader stokers via dosing screw conveyors. The wood chips are then fed into the boiler at the required flow rate under carefully controlled conditions.



The Combustion Process

From the dosing screw conveyors the wood chips are fed into the spreader stokers which evenly spray the fuel across the combustion chamber. Fine particles ignite when entering the combustion chamber while large particles fall onto the water-cooled vibrating grate. The larger particles burning on the grate radiate and ignite the small particles in suspension. Approximately 75% of the energy is released in suspension, depending on the humidity and volatility of the fuel. As most of the combustion takes place in suspension, the necessary primary air constitutes only 25 – 40 % of the total combustion air. The number of holes in the grate varies between the main combustion zone and the burn-out zone; the higher number of holes in the main combustion zone provides a better penetration of the fuel bed, while fewer holes in the burnout zone provides a better distribution of oxygen for the carbon burn-out. The primary combustion air is divided into 3 sections under the water cooled vibrating grate. Due to the combustion occurring throughout most of the volume of the furnace the heat transfer rate to the combustion chamber boiler walls is high and allows an effective cooling of the flue gas. The uniform combustion along with staging of the combustion helps prevent the formation of thermal NOx. The water-cooled vibrating grate is coupled to the boiler drum with flexible tubes, and is a naturally circulating evaporator making the system independent of external cooling. The furnace and boiler is integrated resulting in a more compact boiler plant.

Steam Boiler

The High Pressure High temperature wood-fired steam boiler is based on DP Clean Tech's well proven design. The design of the steam boiler together with the proper selection of materials counteracts the fouling and corrosive effects of the fuel.

The steam boiler is a fully welded water tube boiler with natural water circulation, built as a standing and self supporting structure, in which downcomers form the supporting columns. The boiler has 2 passes; the 1st pass furnace and radiation, and the 2nd pass radiation and convection with superheaters and evaporator. In addition, a separated economizer tower is installed beside the boiler radiation and convection pass, with the air preheater located below.