

In order to achieve high combustion efficiency and low emissions when using agrobiomass, the selection of appropriate, modern combustion systems is very important and each boiler subsystem – feeding system, combustion chamber, heat exchanger, ash removal system, control system and flue gas cleaning system – has to be compatible with the specific biomass's properties.

Usually such systems are automatically controlled and have a moving grate that allows for an effective and complete combustion and automated heat exchanger cleaning in order to prevent ash deposit formation and corrosion.



Modern biomass boiler with moving grate and automated mechanical heat exchanger cleaning

Feeding systems: The majority of modern boilers includes an automatic fuel feeding system. Depending on the form the agrobiomass is available in the market and how it is stored, different feeding systems may be required. The most common fuel feeding systems for granular fuels and chips/hog fuel are **feeding screws**, coupled with **agitators** if needed.

Moving grates: Moving grate burners can achieve a high combustion velocity and efficiency, because the solid fuel moves across the grate from the inlet section to the ash discharge section and this allows a better mixing between air and fuel and facilitates the distribution of char, which then burns more quickly. Moving grates have a different configuration according to the different mechanical principle that moves the grate. The main types of moving grates are: **travelling grates**, **reciprocating grates**, **vibrating grates**, **cigar burners** and **through-screw systems**.

Heat exchanger cleaning: Usually, in small and medium-scale biomass boilers, gas tube heat exchangers are applied (hot flue gas flows inside the tubes while the water flows outside the tubes). A clean heat exchanger is crucial for the lifespan and efficiency of an agrobiomass boiler. There are two main technologies for heat exchanger cleaning, one is based on mechanical means and the other on pressurized air. A pneumatic heat exchanger pipe cleaning system regularly removes the deposited ashes from the heat exchanger with **short bursts of compressed air**, while a mechanical heat exchanger cleaning system moves them by the automatic periodic **reciprocating movement of turbulators**.

Ash removal systems: Ash removal is often considered to be a main drawback with regard to the ease of use in biomass boilers. This is why the de-ashing system is of great importance. Grate ash and ash resulting from the heat exchanger cleaning process are collected in the ash box. De-ashing is typically carried out automatically by a de-ashing screw that conveys the ash into a sufficiently large-sized container.

Control systems: A state of the art automated process control system of a modern biomass combustion plant usually consists of load control, combustion control, furnace temperature control, furnace pressure control and control loops needed for operation safety aspects.



A revolutionary example of state of the art combustion systems with high fuel flexibility are **biomass gasification boilers** that include an updraft gasifier, a gas burner and a hot water boiler. Such systems can achieve almost zero CO and OGC emissions, significantly reduced NO_x emissions (compared to conventional fixed-bed combustion technologies) and very low particulate matter emissions.

Image sources: modern biomass boiler with moving grate and automated mechanical heat exchanger cleaning - CAMINO DESIGN (www.caminodesig.gr), biomass gasification boiler - PuroWIN Windhager (www.windhager.com)



This project has received funding from the European Union's Horizon 2020 research and innovation programme under Grant Agreement No 818369. This document reflects only the author's view. The Innovation and Networks Executive Agency (INEA) is not responsible for any use that may be made of the information it contains.

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