



DP Poultry Litter Biomass Solution

DP CleanTech
Creating value from waste



Introduction

Growing economic, environmental and social imperatives to utilise renewable energy sources have brought a greater focus on developing and optimising technologies for the effective conversion to energy of an increasing variety of waste materials. Whilst animal waste has long been used as a domestic fuel, traditional methods are being replaced by industrial scale processes which are more efficient, productive and environmentally superior. However, the diversity of animal waste that can be used as a biomass fuel means that the combustion of animal litter is as complex as traditional plant based biomass. The challenge of understanding the different characteristics and properties of such fuels is critical to designing a solution which can provide the most efficient combustion; as well as adapting for specific fouling and slagging propensities.

Chicken litter is a suitable and readily available waste material that has great energy potential, but it has specific properties which must be addressed in the design solution.

Common Physical Properties For Poultry Litter

Physical or Chemical Property	Effect of Combustion	Potential Impact
Rich in calcium, phosphorous and potassium-based alkali metals	High alkali content High chloride content	High levels of slagging, fouling and corrosion of the furnace and boiler. High particulate emissions
K and Na	Forms silica salts which become sticky	Forms slag on hot surfaces of the combustion equipment and boiler.
High chlorine level	HCl formation	Increased risk of high temperature corrosion to the furnace and boiler.
High Sulphur level	Releases sulphur content that is >10 x higher than that of wood.	Increased potential for high SO _x emission
Variable moisture content depending on climate and livestock practices	Dry fuel increases the risk of more explosive and fluctuating combustion. Moist fuels require some drying prior to combustion; and more sophisticated combustion systems to handle higher moisture levels.	Fluctuating combustion levels, lower efficiency. Increased energy requirement for drying fuel.
Small particle size	Small particles have a tendency to burn in suspension when using a pneumatic spreader or drop chute feeding system.	Increased risk of high temperature corrosion and higher quantities of fly ash. Fly ash disposal is expensive.

DP Specialist Solution

DP CleanTech has engineered and manufactured over 80 biomass plants worldwide. Our proprietary patented European technology is the basis for the most efficient and robust biomass-fired boiler + water cooled vibrating grate (WCVG) solutions in the world. DP's engineering knowledge and experience originated in Denmark in 1986 and has been extended and improved to efficiently handle over 60 types of fuel. DP's particular strength lies in designing boiler solutions for complex and corrosive fuels that contain high levels of alkalis and chlorine. DP has references for over 50 high performing plants using such fuels.

The DP Specialist solution for 100% combustion of chicken litter to produce electricity and/or process heat is based on DP's longstanding and in depth experience of combusting highly complex, fouling and corrosive biomass fuels in order to address the specific combustion problems associated with chicken litter.



Key Features

Fuel Feeding System

Including feed hopper, chute and hydraulic-driven pusher

Feedwater System

Including deaerator/feedwater tank, boiler feed pumps, feedwater pipeline to boiler

Boiler

Including water-cooled vibrating grate, furnace and steam boiler pressure and non-pressure parts

Combustion Air & Draft System

Including air ducts, force draft fan and induced draft fan

Flue Gas Treatment System

Including flue gas ducts, absorbent injection reactor, bag filter and chimney stack

Boiler Bottom Ash/ Slag Ash Removal System

Submerged chain conveyor

Fly Ash Removal System

Chain conveyor, bucket elevator, screw conveyor and silo

Steel Support Structure, Galleries, Platforms, Stairs and Boiler Roof and Siding

Control & Instrumentation

Advanced Automatic Boiler Process Control and Dedicated Protection System

Designed Performance Parameters

Load Capacity (MCR)	Main Steam Flow	Main Steam Pressure	Main Steam Temperature	Power Output (MWe)	Fuel Consumption
100%	40-150 t/h	60-70 Bar(a)	450-480°C	10-40	

Key Benefits



Corrosion Preventative Superheating

DP's boiler design is a three-pass vertical arrangement with water-cooled wall membranes and a single uncooled fourth pass (the economiser tower). The boiler is equipped with horizontal bare and fin-tube Superheaters located in the third and fourth pass. The flue gas is reduced to below 800°C before entering the superheater pressure parts in the third pass. This design minimises the risk of high temperature corrosion, a common problem with hanging superheaters located in the first and second pass.



Controlled Fouling

DP's advanced control system (DPAAC) automatically regulates the furnace and boiler temperatures to maintain stable operation, whilst minimising minimum flue gas temperature fluctuations and reducing the fouling of pressure parts. Excessive fouling of the boiler is removed by water lance blowers.



Steady Pusher Fuel Feeding

The pusher fuel feeding system slowly feeds the chicken fuel into the furnace and maintains an optimum layer of fuel on the combustion grate. This minimises the risk of fuel blockages and bridging usually found with drop chute and dosing silo-reclaimer feeding systems.



Stable Combustion Control

Slow, steady pushing of the fuel onto the grate, interspersed with short periodic vibrations of the combustion grate and automatically controlled combustion air enables steady combustion with less fluctuation. Pushing fuel rather than using an pneumatic spreader or drop chute minimises the amount of fuel burning in suspension (which can increase the risk of fouling and corrosion in the first and second pass).



Reduced Fly Ash

Chicken litter has a high ash content of up to 20% when dry. The pusher system ensures that only 20% of this overall ash content becomes fly ash (compared to other feeding systems that produce 50%). Around 80% of the ash is removed from the boiler as bottom ash. This can be sold as fertiliser.



Reduced Maintenance

DP's water-cooled vibration grate (WCVG) is less prone to high-temperature corrosion and has fewer moving parts, requiring less maintenance than other grate technologies.



High-Volume Fuel Handling System

The fuel handling system is over-sized to handle low quality fuels consisting of up to 25% ash.

Emissions Handling Features

DP's Flue Gas Treatment (FGT) plant provides a proven, simple and effective method of meeting the required emission limits.

- NO_x suppression - NO_x formation is suppressed by controlling the combustion air by spraying water into the furnace hot spots. This alternative method is tried and tested at all four Chicken Litter-fired power plants under operation in the UK, with NO_x levels below 200 mg/Nm³. It is both effective and significantly less expensive than using Selective Non-Catalytic Reduction (SNCR) with Ammonia or Urea injection.

- SO_x scrubbing – Dry flue gas cleaning system with Hydrated Lime injection to remove SO_x pollutants from the flue gas. Meets emissions limits with a lower O&M cost than semi-dry systems.



- Increased bag filter capacity – to handle higher levels of fly ash in the flue gas. This also reduces bag cleaning frequency and increases bag life.

- Efficient scrubbing - Maximum contact time between the reagent and flue gas in the reactor tower, ensures effective mixing before entering the fabric filter section.

Key Benefits



Guaranteed Emissions Reduction

The FGT has been installed at multiple plants in the UK and Asia, operates successfully and consistently achieves mandatory emission limits.



Reduced Maintenance Costs of FGT

The dry flue gas cleaning system meets emission limits to be met at lower maintenance and operating costs than semi-dry and wet systems.

Quality Standards

DP equipment, materials and systems are designed and manufactured in accordance with the latest prevailing codes and standards.

- TSG - Special Equipment Safety Specification
- GB - China National Standard
- ASME - American Society of Mechanical Engineers
- PED - Pressure Equipment Directive
- EN - European Norm
- BS - British Standard
- JIS - Japanese Industrial Standard

Boiler Design Layout and Overview

The boiler is of similar size and appearance to the Mahachai Green Power 9.9MWe biomass power plant commissioned by DP in 2016. The design is based on the DP MaxMulti solution with proprietary water cooled vibrating grate (WCVG) technology.



Key Features and Processes

- Biomass power plant: 10 to 40 MW gross electric power capacity
- Fuel feeding system (hydraulic pusher): reduced risk of fuel bridging/ blockage, stable combustion and reduced fly ash quantities.
- Boiler system: medium pressure, medium temperature boiler for optimal system efficiency and reduced fouling and corrosion of boiler pressure parts.
- Flue gas cleaning system: Advanced system with Hydrated Lime injection SOx scrubbing and higher-volume fly-ash capacity bag filters.
- Control and protection system: 100% automatic, low opex and high reliability.
- Back-up power: 40% load oil burner and diesel genset (for critical systems).
- Turbine Island: high-quality; cost efficient partners (e.g. Siemens, ShinNippon)
 - Automatic speed control, voltage regulation, protection and synchronisation.
- Cooling system: water or air-cooled (depending on water availability)

DP Specialist Boiler (Poultry litter)

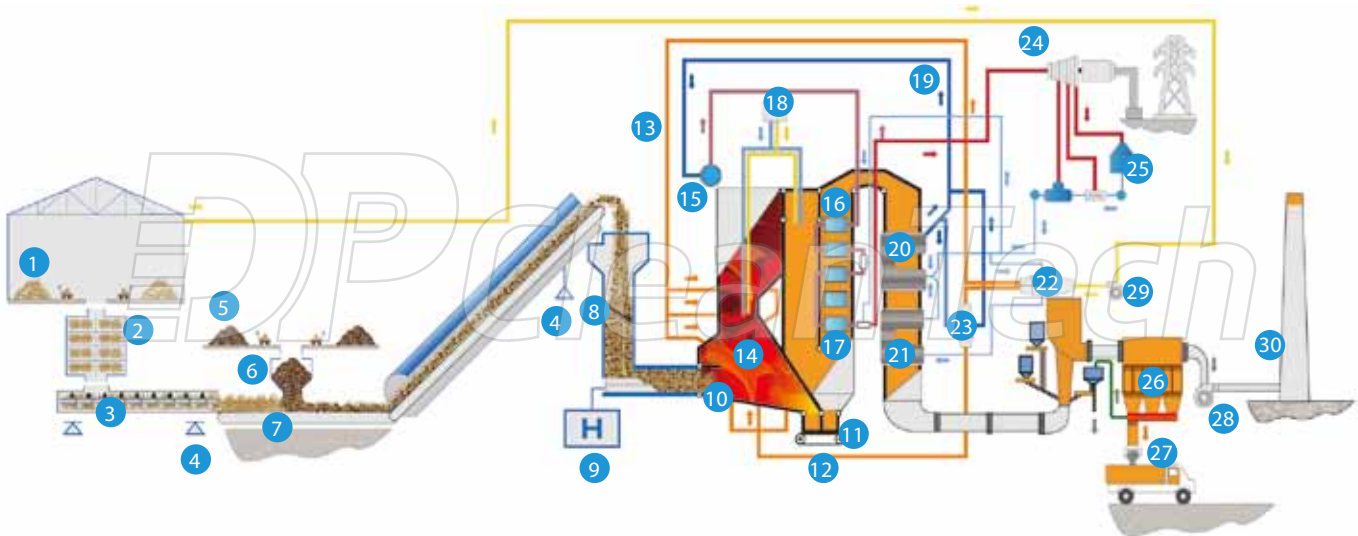


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|---------------------|-----------------------|----------------------------|---------------------------|
| 1 Shredded fuel | 9 Hydraulic station | 17 Superheater 2 | 25 Water-cooled condenser |
| 2 Walking floor | 10 Vibrating grate | 18 Water lance blowers | 26 Bag filter |
| 3 Screw conveyor | 11 Slag conveyor | 19 Boiler feed water | 27 Ash handling |
| 4 Weight cell | 12 Primary air | 20 Economizer | 28 ID fan |
| 5 Non-shredded fuel | 13 Secondary air | 21 Flue gas cooler | 29 FD fan |
| 6 Feeding hopper | 14 Combustion chamber | 22 Air preheater 1 | 30 Stack |
| 7 Belt conveyor | 15 Steam drum | 23 Air preheater 2 | |
| 8 Pusher feeder | 16 Superheater 1 | 24 Steam turbine generator | |



About DP CleanTech

- ✓ DP CleanTech designs, engineers, manufactures and commissions biomass and waste-to-energy power plants, providing complete solutions for turning waste materials into clean energy.
- ✓ DP CleanTech has over 80 biomass power plant references around the world using high pressure, high temperature technology originally developed in Denmark.
- ✓ DP CleanTech built the first biomass power plant in China and is responsible for over 30% of the biomass power plants operating in China today.
- ✓ DP CleanTech is recognized as a world leader in the biomass clean energy field.



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