AKKAYA
BOILERS

USER MANUAL

WCVG MODEL
WATER COOLED VIBRATING GRATE

WCVG – WATER COOLED VIBRATING GRATE SYSTEMS

Figure 1 WCVG – Water Cooled Vibrating Grate System Under Hybrid Boiler

WCVG is one of the newest technologies used in the combustion of various types of solid fuels. The principle is to move the fuel on the grate with the effect of vibration created by a vibro-motor.

With the water-cooled grate area, fuels with low melting temperature can be burnt. The system provides flexibility in burning a wide range of solid fuels and biomass types.

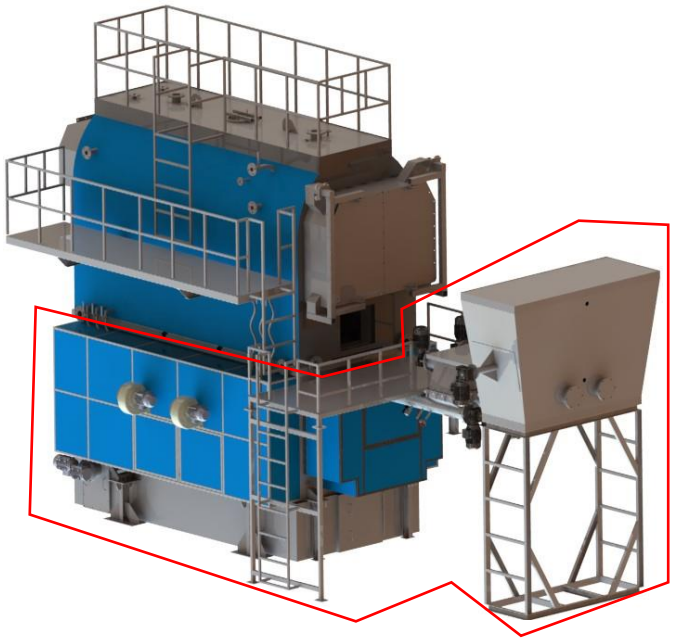

Figure 2 WCVG – Installed under a Semi Cylindrical Boiler

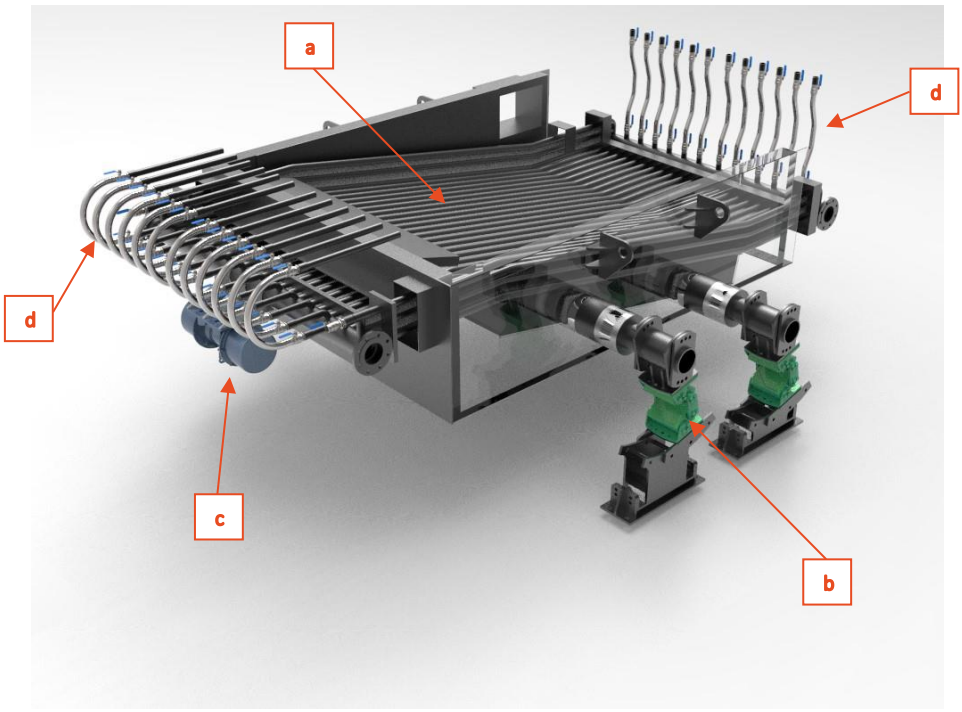

Figure 3 WCVG – Water Cooled Vibrating Grate Components

The WCVG system main components are,

a) Grate with membrane wall tubes: The membranes have air injection holes to supply primary air under the fuel bed. The grate is the surface that fuel completes its combustion. The grate is installed with a minimum inclination to help the movement of the fuels from top to bottom.

b) Oscillation elements: These elements can be ready made oscillating elements with special rubber cords, leaf springs or spiral springs. The type of the oscillating element depends on the design. Detailed information can be obtained from Akkaya Technical Service. The oscillating elements used to give direction to the fuel feed.

c) Vibration motor: The vibration motor can be one piece or at multiple numbers. In some applications instead of vibration motor, a mechanical cam system can be used to give the vibration movement.

d) Water loop connection hoses with valves: These hoses or tubes are used to provide water circulation inside the grate tubes. The water loop can be connected to the boiler's own water circuit or to an external cooling loop.

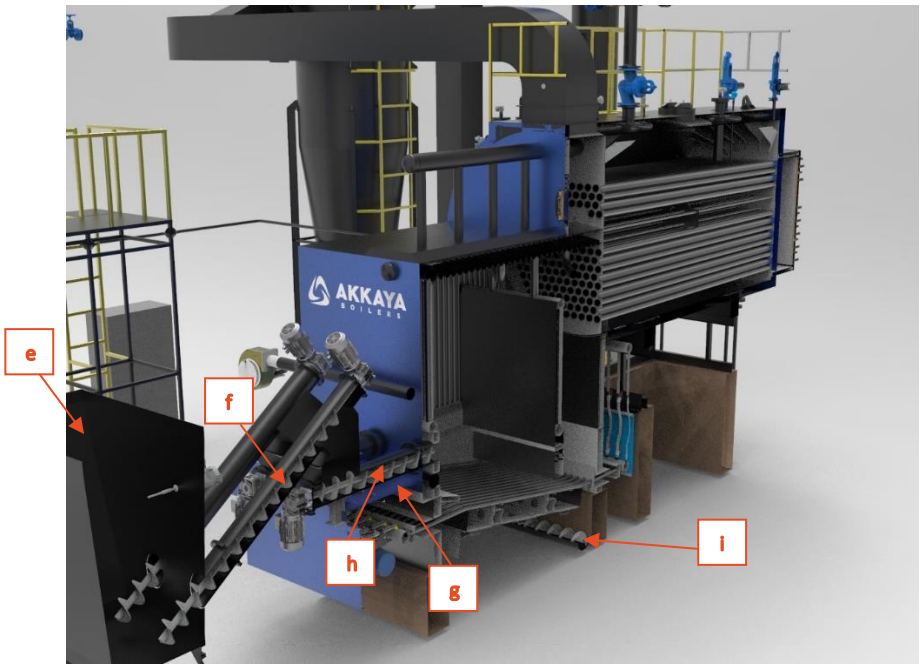

Figure 4 WCVG – Water Cooled Vibrating Grate Components

e) Fuel bunker: As an option the fuel bunker can be supplied with level controller and fuel mixer.
f) First Stage Auger: First stage screw feeder line.
g) Second Stage Auger: Second stage screw feeder line.
h) Fire extinguisher thermostatic valve.
i) Ash remover

The proper fuel specifications for WCVG:

Moisture:

The moisture level is suggested to be as low as possible (less than 5%) to obtain required power out of combustion. The moisture level can affect the particle structure of the fuel which is quite important for transportation with screw augers. The high moisture can cause slag formation and unburnt ash formation. Considering all these factors the moisture level must be kept below 30%. With WCVG it is possible to increase the combustion chamber's temperature to help to burn high moist fuels. If the fuel feeding and transport issues can be solved up to 50% high moist fuels can be burnt with a WCVG with a proper furnace design.

Dimensions:

Recommended dimensions for standard WCVG have 5-50 mm particle size.

With special feeding mechanisms and with changing the grate membrane design the particle size dimensions can be enlarged to (1 mm to 100 mm)

200 – 1100 kg/m3 density.

The fuel should have a density and particle structure suitable for transportation with an automatic system. The fuel must not cause accumulation or bridge formation in the fuel bunker, it must easily fall from the screw/feeder. If bridge formation occurs inside the bunker, additional measures like mixing arm installation must be applied.

Calorific Value:

The preferred calorific values are within the range of; Min. 3000 kcal/kg Lower Calorific Value (LHV) – Max. 7500 kcal/kg (LHV). The boiler's combustion chamber volume design, grate surface area selection, fuel feeding rate, heat transfer surface area construction and steam output capacity of the boiler depend on the calorific value of the fuel. The calorific value changes by the moisture level and fuel's elementary structure. The correct selection of the fuel is quite important to get the required steam output.

Ash Content:

The chemical composition of the fuel and the structure of the ash should not allow slag formation. The ash melting temperature should be above 900 °C. For normal operation, the ash content ratio by mass is recommended to be between 10% and 25%.

The solid fuels composition has big impact on the combustion efficiency and safe operation of the boiler please check the below table to understand the effect of elements on fuel composition.

SUBSTANCE IN FUEL COMPOSITION	Unit	EFFECTS
S SULFUR	kg/kg	**S > 0.1wt% (d.b.):** There is a risk of corrosion. It is necessary to increase the thickness of the material in the boiler or the need for coating application occurs in critical areas. An automatic cleaning system should be installed, frequent cleaning should be done. It is recommended to change or leach the fuel. **S > 0.2wt% (d.b.):** There is an additional risk of SO_x emissions. The fuel should be leached, and a special filter should be used for precaution.
N NITROGEN	kg/kg	**N > is 0.6wt% (d.b.):** There is a risk of NO_x emissions. Attention should be paid to EGR, air and combustion chamber design. Additional warning **N>2.5wt% (d.b):** There is a high risk of NO_x emissions, SNCR or SCR should be applied.
Cl CHLORINE	kg/kg	**Cl > 0.1wt% (d.b.):** There is a risk of corrosion and HCl emissions, it is necessary to increase the thickness of the material in the boiler or the need for coating application occurs in critical areas. An automatic cleaning system should be installed, frequent cleaning should be done. It is recommended to change or rehabilitate the fuel. Use a special filter for HCl emission. **Cl > 0.3wt% (d.b):** It is recommended to use PCDD/F emission risk and activated carbon filter as an additional warning.
Ca CALCIUM	kg/kg	**Ca > 35wt% (d.b.):** There is a risk of low ash melting temperature. It is recommended to apply a water-cooled grate and a low combustion chamber temperature. There is often a need for cleaning the grate and boiler.
K POTASSIUM	kg/kg	**K>7wt% (d.b.):** Low ash melting temperature, there is a risk of pollution, slag, corrosion, and aerosol formation. It is recommended to apply a water-cooled grate and a low combustion chamber temperature. Increase material thicknesses or apply coating in critical areas, install automatic cleaning system, need to clean the grate and boiler often. Special filter application and fuel reclamation are recommended
Zn ZINC	kg/kg	**Zn > 0.08wt% (d.b.):** There is a risk of unburned ash, pollution, high emission of particles. Heavy metal separation, ash recycling system, automatic cleaning system should be installed. The need for frequent cleaning of the grate and boiler occurs. Special filter application and fuel reclamation are recommended.
Cd CADMIUM	kg/kg	**Cd > 0.0005wt% (d.b.):** There is a risk of unburned ash, pollution, high emission of particles. Heavy metal separation, ash recycling system, automatic cleaning system should be installed. The need for frequent cleaning of the grate and boiler occurs. Special filter application and fuel reclamation are recommended.
TashM Fuel Ash Melting Temperature	C	**TashM < 1100 °C:** There is a risk of slag and high pollution. Automatic cleaning, water cooled grate, boiler with low furnace temperature and frequent grate and boiler cleaning are recommended.
Fuel with size (0-5 mm)	%	**>10%:** There is an increase in the amount of fly ash and a decrease in combustion efficiency.

Fuel Feeding and Ash Removal Adjustments of the WCVG Systems

a) WCVG systems are fed with time-controlled augers. Auger adjustments are determined according to the capacity of the boiler. To prevent the fire from flowing back towards the bunker. The two-stage feeding must be operated in a manner to ensure that the fuel in the second stage is completely discharged. This is done in that way; when the system (boiler) will go to a standstill, the second stage screw must operate 10 more seconds than the first stage screw. (This period may vary depending on the design of the system). Akkaya Technical Service must be consulted for proper adjustment.

b) Fuel distribution should be adjusted to have a distribution as seen in the below figure. When the grate surface is divided into 3 sections, 1st section with 20 cm thick fuel bed is the fuel entrance and primary gasification section. 2nd section with approximately 10-5 cm thick is the section where the main combustion occurs. The 3rd section is the part of grate where the combustion is completed, and ash is formed.

c) Vibration time should be determined according to fuel distribution. It is not preferred that the vibration motor works too fast and too much. (For example: It is appropriate to work for 10 seconds every 1 or 2 minutes). The less vibration amplitude and the less working frequency is the best operational condition. Increasing the vibration amplitude will cause mechanical failures to happen in a short time.

d) If there is automatic ash removing system, to protect the ash remover screws from unburned fuels and high temperature, the ash in ash extraction systems should always be kept 5 cm above the ash carrying screws (augers). Ash discharge dampers should be checked frequently to ensure that they are fully closed. If any ash and slag are trapped in the covers of these dampers, they must be cleaned manually. If the dampers are not fully closed, air enters the ash removing system and causes burning and deformation in that area. In addition, the air sucked from the ash damper also disrupts the air/fuel adjustment in the boiler combustion chamber. Ash discharge is of great importance. If ash accumulates excessively, there is a possibility of slag forming.

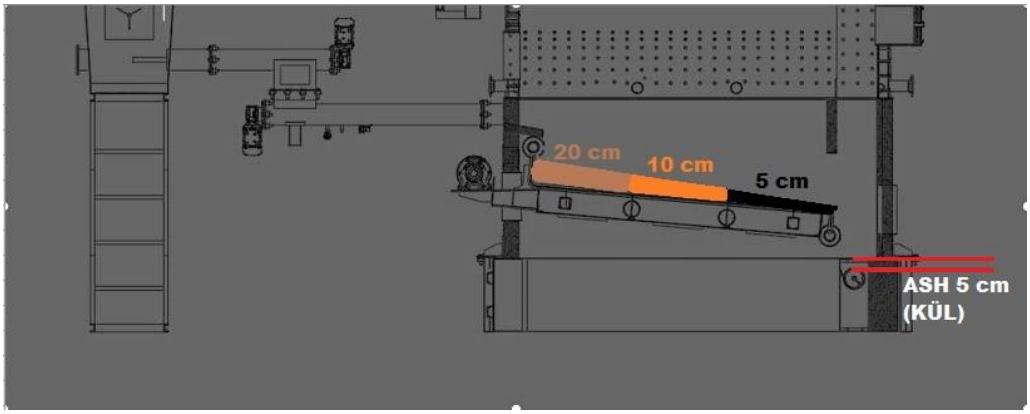

Figure 5 WCVG – Water Cooled Vibrating Grate Fuel Distribution

e) WCVG bottom collector and hand hole must be checked and cleaned if scaling or mud accumulation occurs.
f) The system's all bolts and nuts must be checked and tightened at least once in a month. These nuts can get loose due to vibration.
g) The ash port and primary air holes must be kept clean always.
h) The fuel / air adjustment and secondary air adjustment must be done by Akkaya Technical Service.
i) The oscillating elements position and condition must be controlled during operation.
j) Any unusual noise or vibration on the boiler or grate body must be reported to the Akkaya Technical Service.

AKKAYA
BOILERS

1 OSB Yerli Su Sokak No: 2
Selçuklu /Konya / Turkey

+90 332 248 92 21
+90 332 248 91 45

+90 332 248 77 10

akkaya@akkaya.com.tr

akkaya.com.tr

/akkayaboilers