

Technologies and Products

Fundamentals

The multi-fuel & multi-process (aka horizontal type) circulating fluidized bed boiler is jointly developed by Nowva Energy Co., Ltd (Nowva) and Tsinghua University. The above-mentioned boiler is efficient, energy-saving, environmental, and stably operated medium & small circulating fluidized bed boilers. The boiler creatively extends single-stage furnaces of traditional vertical circulating fluidized bed boilers to three-zones, upgrades single-stage ash circulation to a three-stage one, and converts high-temperature material separation into a medium-temperature one.



On the one hand, the adopted technologies of the boiler make the effective combustion space of the boiler's furnace bigger and prolong the combustion time of fuels. Meanwhile, the structure of two-stage material circulation is beneficial to the circulation of unburned combustibles, which guarantees complete combustion of fuels and strengthens the adaptation of fuels. On the other hand, converting high-temperature separation in boilers into a medium-temperature one can avoid coking of fuels with low ash fusion point in separators. This boiler has outstanding emission characteristics for environmental protection, which makes clean combustion & utilization of coals come true. When being jointly applied with SNCR and FGD, this boiler can help to make the emission of solid-fuel boilers reach the emission standard of gas-fired boilers.

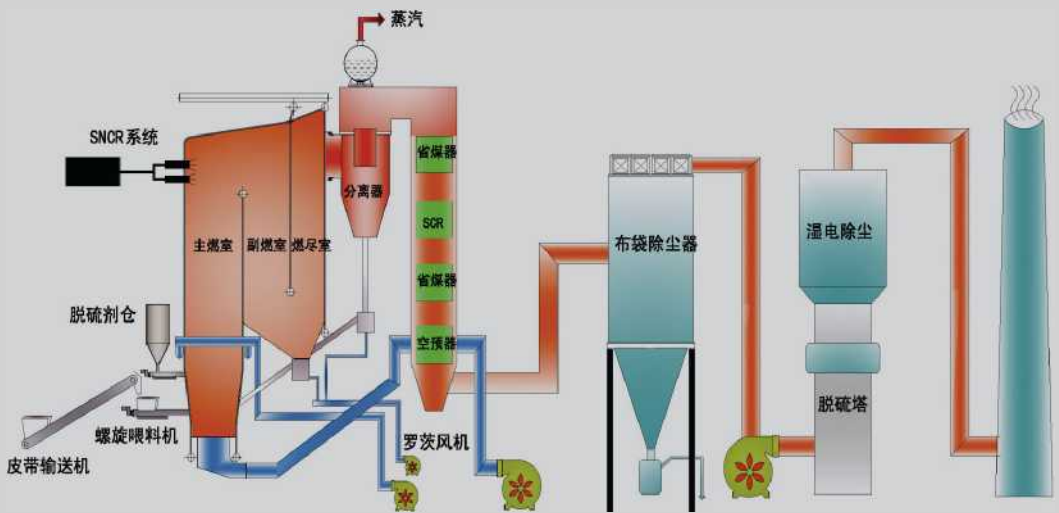
This boiler has features such as high thermal efficiencies (real operation efficiency: 88–92%), good environmental performances (desulfurization in the furnace and low-NO_x combustion), flexible fuel adaptation (suitable to different coals, biomass, and combustible solid wastes), significant energy-saving effects, stable operation processes. This boiler can solve not only problems of layer-fired boilers such as low combustion efficiencies, high NO_x emissions, and unachievable desulfurization in the furnace but also problems of traditional vertical circulating fluidized bed boilers like tall furnace body and high costs. Promotion of this boiler is meaningful to the achievement of energy conservation & consumption reduction of industrial boilers and environmental protection. This boiler is suitable for hot-water or steam boilers of 6160 t/h, whose emission standard is better than the special emission limit of gas-fired boilers (according to Emission standard of air pollutants for boiler GB13271-2014). In this way, this boiler could make ultra-clean emissions come true: dust $\leq 5\text{ mg/m}^3$, SO₂ $\leq 35\text{ mg/m}^3$, and NO_x $\leq 50\text{ mg/m}^3$.



Main Technical Parameters

Type of boiler	multi-fuel & multi-process circulating fluidized bed boiler
Capacity range of boiler	6–160 t/h
Pressure range of boiler	low-temperature & low-pressure steam boilers, medium-temperature & medium-pressure steam boilers, high-temperature & high-pressure steam boilers and hot-water boilers
Thermal efficiencies	88–92%
Suitable fuels	bituminous coals, anthracite, lignite, lean coals, coal gangue, oil shales, biomass fuels, agricultural wastes, coffee grounds, residues of traditional Chinese medicine, furfural residues
Range of calorific value	1500–6000 kcal/kg
Furnace box temperature	850–900 °C (depending on operation situations of coal combustion)
Inlet temperature of cyclone separator	~500 °C
Outlet temperature of flue gas for boiler	≤ 145 °C
Carbon-containing rate of bottom slag	$< 1\%$
Structure of furnace	membraned walls
Heat-transfer medium	water or conduction oil
Initial nitrogen oxide emission	≤ 200 mg/m ³
Control method of NO _x	low-temperature combustion + “coupling of SNCR & SCR”
Desulfurization method	addition of limestone to the furnace + fine desulfurization in the tail stage
Dusting method	high-performance bag dust-cleaning + wet electrostatic dust-cleaning

System technology processes



Primary air and secondary air are individually provided by different fans, whose ratio (of primary air to secondary air) can be adjusted according to types of fuels. The dense-phase area in the furnace belongs to turbulent beds, whose temperatures are always controlled within 850–900 °C (depending on operation conditions of coal combustion). In this way, low-temperature anoxic combustion conditions are generated in the dense-phase area, and formation amounts of NO_x are reduced. Meanwhile, most of the heat in fuels is released in this area. After that, unburned carbon particles flow into a suspension stage and get fully burned in the oxidation zone formed by secondary air.

Produced through combustion, high-temperature flue gas with solid particles goes into a sub-combustion chamber. In the bottom area of the chamber, the temperature of flue gas decreases to about 700 °C, and flue gas enters the ash recovery device. In the device, gas-solid separation is performed via inertial mechanical separation. Then, the separated solid particles enter into the dense-phase area of a main-combustion chamber via the ash recovery device and start combustion. Next, the high-temperature flue gas gets into a burnout chamber and goes through a second gas-solid separation in a cyclone separator when its temperature decreases to around 500 °C. Most recycled particles after the second separation are sent to a reinjection device. Through a feedback door, those recycled particles are sent to dense-phase areas to take part in the above-mentioned circulation again. The high-temperature flue gas separated from the cyclone separator flows through a tail shaft, whose heat is extracted by economizers and air preheaters once again. Finally, the temperature of flue gas decreases to around 145 °C, and then flue gas is emitted into the atmosphere after a dusting stage and a desulfurization stage.



Pictures:

1. Flow chart of multi-fuel & multi-process circulating fluidized bed boilers
2. Project case 1 (Henan Province, P. R. China; Capacity: 13 t/h; finished in May 2014)
3. Project case 2 (Sichuan Province, P. R. China; Capacity: 20 t/h; finished in August 2014)