

STEAM BOILERS, POWER FUEL, BURNER FACILITIES, AND AUXILIARY EQUIPMENT OF BOILERS

The Production of Activated Carbon Using the Equipment of Thermal Power Plants and Heating Plants

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Abstract—The production technology of activated carbon using the conventional equipment of the thermal power stations and boiler houses is proposed. The obtained product is directed into the systems of chemical water preparation and water drain of enterprises. The production cycle is invariable when producing the activated carbon by the proposed technology. The fuel consumption and heat losses are considerably reduced when implementing this technology compared with the known analogs of the carbon sorbent. The production efficiency increases if small dust particles are preliminary separated and coal is activated in narrow ranges of fraction sizes.

Keywords: activated carbon, boiler, combustion, burning

DOI: 10.1134/S0040601513070082

Activated carbon is used as a sorbent in the systems of chemical water treatment and in the wastewater disposal systems at industrial enterprises, including thermal power plants and heating plants. In view of large consumption of fuel and electric power and heat losses in manufacturing activated coal by means of a traditionally implemented method on the stand-alone equipment, for example, in rotary kilns in fluidized bed plants, this product becomes increasingly costly [1]. The prime cost of the sorbent can be reduced, if its production is organized with extraction of part of the heat from the plants that generate heat directly at the enterprise. In this case the basic technological cycle of the generation of thermal energy remains the same, while heat needed for carbon activation is only consumed by the systems of chemical water treatment and by wastewater disposal systems.

The technology of carbon activation proposed below is implemented by means of preliminary separation of fine particles of raw coal (up to 1 mm in size), which then are admitted for coal-dust firing to main heat-generating plants, and by means of the separation of larger fractions within the narrow size range (from 1 to 2 mm, from 2 to 4 mm, from 6 to 8 mm, and so on), with subsequent supply to the heat-generating plant for gas-flame thermal treatment with the purpose of removing moisture and volatiles. The activated coke is delivered to the consumer.

The need for separating narrow ranges of coal-dust fractions (fractionation) stems from the special feature of the process of combustion of coal particles that has sequential time periods. The lengths of these periods depend on the fixed size of raw particle δ_i , oxidant concentration C_{O_2} , and the thermal background in the chamber—the gas temperature T_g [2].

The first period is characterized by non-flaming particle heating with the release of moisture and natural combustible volatiles, and it is calculated in seconds from the formula:

$$\tau_{mi} = 5.3 \times 10^{14} k_m T_g^{-4} \delta_i^{0.8}. \quad (1)$$

The following heating of particles and released volatile components in the oxygen medium brings about inflammation and combustion of volatiles; time of their burnout, in seconds, is determined from the relationship:

$$\tau_{c.vi} = 0.5 \times 10^6 k_{c.v} \delta_i, \quad (2)$$

and time of the onset of oxidation of coke of the i th particle (coke inflammation), s, is:

$$\tau_{c.ii} = 1.12 \times 10^{10} k_{c.i} \rho_{cd} \delta_i^{1.2} T_g^{-3} (21/C_{O_2})^n, \quad (3)$$

where ρ_{cd} is coal density, kg/m³; $n \approx 0.5$. In the formulas (1)–(4) k_m , $k_{c.v}$, and $k_{c.i}$ are coefficients obtained experimentally.