ROASTING PETROLEUM COKE IN A MULTISTAGE COUNTERFLOW APPARATUS WITH A FLUIDIZED BED

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Carbonaceous substances intended for the production of electrodes are subjected to preliminary roasting to improved their physical and chemical properties (to remove volatile components, increase their density, improve their electrical conductivity and mechanical strength, increase their chemical inertness, etc.).

At present, they are roasted industrially in rotating or retort furnaces [1]. This requires considerable capital and running costs, owing to the low output and large size of the roasting furnaces and the complexity of the process. Another drawback is that one cannot roast fines smaller than 25 mm. However, even in slow-roasted coke this fraction reaches 70%.

The lack of an industrial method for roasting fines is preventing the economic utilization of existing reserves of low-sulfur coke.

Fines from petroleum coke can be most efficiently roasted by using the principle of the fluidized bed, which, as the most up-to-date method for thermal processing of granular material, is widely used in various branches of industry [2, 3].

According to the conditions of heat exchange, fluidization, and possible entrainment out of the separation zone, the most suitable particle sizes for roasting in a fluidized bed are from 0.5 to 10 mm.

The fluidizing agent can be either hot flue gas, which must also serve as heat-transfer agent, or heated air, which reacts with part of the coke to emit heat required to roast the remaining mass to the required temperature.

The temperature conditions of roasting must be maintained so as to obtain coke of the quality required by the electrode industry. However, it should not be too high, so as to avoid intense reaction with the carbon of carbon dioxide and water vapor in the flue gas; such secondary reactions are accompanied by the absorption of a great deal of heat, loss of coke, and thus increase of ash content. It is found in practice that the carbonaceous material for electrodes must be roasted at about 1300°C [4].

Minimum coke losses during roasting will be observed in the case of maximum utilization of the physical and chemical heats of the fuel combustion products: this may be realized in a multisection apparatus with fluidized or "fountain" beds [5].

In this type of apparatus, roasting can be intensified by utilizing the heat of complete com-
The coke is roasted in two stages. Preliminary roasting at 600-900°C is effected in the upper section of the reactor by flue gases from the lower section. We found that at these temperatures coke losses are negligible. The weight of the raw coke is reduced only by separation of volatile substances and water. In the lower section the temperature of the fluidized bed is raised to 1200-1300°C by combustion of part of the coke. For this purpose air at 700-1100°C is fed up to the lower plate. Coke from the lower section is dropped through an intermediate feed into a soaking (annealing) chamber to complete the processes of structural ordering. The intermediate feed also acts as a seal between the flue gases and the coke entering the soaking chamber. The roasted coke is cooled, fed by a bulk loader into a mechanized receiver, and transported out of the premises by means of an electric winch.

The outgoing flue gases are continuously analyzed by optical-acoustical gas-analyzers for carbon-monoxide and carbon-dioxide content. The temperatures of the sections are measured by "PP" thermocouples.

An inspection window is fitted for visual observation of the coke level in the soaking chamber and for measurement of the temperature by means of an optical pyrometer.

The body of the apparatus is built of chamotte brick with aluminum oxide contents of 30-40%. To ensure uniform motion of the coke particles throughout the cross section of the soaking chamber, the bottom of the apparatus has a spreader cone made of refractory chamotte slabs cut to circular shape on a lathe. Its dimensions and angle were established beforehand by simulation on a cold test rig.

The perforated fettlings of the sections are also made of chamotte slabs 70 mm thick. 10-mm diameter holes are drilled in them in checkered array. The total cross section of all the holes is 4.5-5% of the reactor cross section. To reduce their resistance, the holes are opened out to 15 mm diameter to a depth of 40 mm from below. The fettlings consist of two halves and are attached to projections in the reactor wall so that they can be replaced if they develop faults. The distance between fettlings is 1 m. The coke feeder and discharger are of the same type and each consists of a four-bladed rotor joined by a flexible shaft to a gearbox and electric motor.