ICS 77.010
CCS H 04

NATIONAL STANDARD OF THE PEOPLE'S REPUBLIC OF CHINA

GB/T 44029-2024

Technical specification for continuous carbonization of low-rank coal breeze by indirect heating process

低阶粉煤外热式连续干馏技术规范

Issued on: May 28, 2024 **Implemented on: December 1, 2024**

Issued by: State Administration for Market Regulation;
Standardization Administration of the PRC

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3 Terms and definitions

3.1 Low-rank coal breeze is defined as long flame coal, non-caking coal and some brown coals of low metamorphic grade, non-caking or weakly caking and high in volatile matter, with a particle size below 30 mm.

3.2 Indirect heating continuous carbonization is defined as the continuous carbonization process in which the coal charge is heated indirectly in an environment sealed off from air.

3.3 Indirect heating vertical retort is defined as the indirect heating vertical carbonization furnace into which the raw coal is charged continuously at the top and from which the semi-coke product is discharged continuously at the bottom.

3.4 Coal tar recovery rate is defined, as printed, as the percentage of the actual tar yield of the carbonization plant to the tar yield of the standard aluminium retort test method.

4 Technical requirements

4.1 General provisions. The explosion and fire hazard zoning of the systems and production units is to meet Annex A and Annex B of GB 51208-2016, and the process flow of indirect heating continuous carbonization of low-rank coal breeze is shown in Figure 1.

4.2 Raw coal and fuel. The design of the raw coal handling system is to meet GB 12710, GB 15577 and GB 50058. The coal store is to be an enclosed building and the coal turnover time is to be not more than 7 d. The total daily running time of the coal handling system is to be not more than 18 h. Cable trays should be placed in the galleries and outside the building; where they are placed inside the building, hydraulic or vacuum cleaning provision is to be considered. The surface limit temperature of the heating installations of the coal handling system is to be not more than 60 °C. On fuel, the heating may use gas from an internally heated vertical retort, producer gas or gas from the indirect heating vertical retort itself, and the impurity content of the heating gas is to meet GB/T 13612.

4.3 Process parameters. Table 1 gives the main technical parameters for calculating the design capacity of the retort, with the item, the unit, the figure and a remark. The working year is 365 d. The residence time in the carbonization chamber is 8 h to 15 h. The carbonization chamber height is 8 000 mm to 12 000 mm, its mean width 300 mm to 450 mm and its length more than 3 000 mm. Three temperature bands are then fixed, low temperature 500 °C to 700 °C, medium temperature above 700 °C to 850 °C and high temperature above 850 °C to 1 000 °C; the row heading that names this group of rows is missing from the extraction. Against those bands the table sets the semi-coke yield, at more than 60 % to 65 % for low temperature, more than 55 % to 60 % for medium temperature and 50 % to 55 % for high temperature; the gas output on a dry coal basis, at 200 to 300 cubic metres per tonne, more than 300 to 400 and more than 400 to 500 respectively; and the tar recovery rate, at more than 85 % to 90 %, more than 80 % to 85 % and not more than 80 % respectively. The remark against the three yield groups states that the product yields are to be settled from the results of a carbonization test to GB/T 480. Table 2 gives the heat consumption figures. The carbonization heat consumption on a wet coal basis is 1 902 kJ/kg to 2 362 kJ/kg where the retort is heated with its own gas and 2 474 kJ/kg to 2 694 kJ/kg where it is heated with gas from an internally heated vertical retort or producer gas; the last column of the table gives the change in heat consumption for each 1 % change in the moisture of the raw coal, 29 in the first case and 33 in the second. The standard flue temperature is 850 °C to 900 °C for low temperature carbonization, above 950 °C to 1 000 °C for medium temperature carbonization and above 1 050 °C to 1 300 °C for high temperature carbonization. A note states that the standard heat consumption figures correspond to a raw coal, wet basis, moisture of 15 %.

4.4 Retort body. The retort is made up of carbonization chambers, combustion chambers

and regenerators. There are two doors to each row of carbonization chambers, the chambers alternating with the combustion chambers, and the upper and lower regenerators are placed on the other side of the body. The lower part of the carbonization chamber is to be wider than the upper part, the taper being not less than 100 mm. The high temperature main body of the retort is to be built of silica brick. Regenerators and combustion chambers are to correspond one to one.

4.5 Process layout. A single retort is to have not more than two rows of twenty carbonization chamber doors. Each group of retorts is made up of one or more retorts. A platform is to be provided between adjacent retorts, and an end platform and a stair well at each end of a group. A coal bunker is to be provided on top of the retort, its effective capacity covering 8 h to 12 h of continuous production. A drying unit should be provided before the raw coal enters the retort, preferably on top of the retort. The retort is to be housed in a building, with the discharge area left unenclosed.

4.6 Key process equipment. Charging: a double chamber, double valve arrangement, closed, is to be fitted between the top bunker and the carbonization chamber, and the charging system is to charge coal continuously, automatically and manually. Gas collecting: the raw gas temperature in the ascension pipe is to be held at 200 °C to 300 °C; the outer wall of the ascension pipe is to be protected against high temperature; low pressure ammonia liquor spraying is to be fitted on the goose neck and the collecting main, preferably at 0.15 MPa to 0.25 MPa, and a high pressure ammonia liquor cleaning device is to be fitted at the bottom of the main, preferably at 2 MPa; the total ammonia liquor sprayed is to be not more than 5 cubic metres per tonne of dry coal; the raw gas temperature in the collecting main is to be held at 80 °C to 100 °C; a raw gas bleeder with automatic ignition is to be fitted on the main and is to open automatically when the pressure in the main reaches 300 Pa for more than 10 s; the main is to have an emergency water or nitrogen filling line; it is to carry temperature and pressure instruments fitted with anti-blocking devices; and the raw gas line is to have an automatic pressure regulator interlocked with the gas blower, the pressure fluctuation in the collecting main on top of the retort being not more than plus or minus 50 Pa. Heating: the heating gas line is to have automatic flow regulation and pressure detection, the pressure detection being interlocked with the shut-off valve of the gas line so that an alarm sounds when the line pressure falls below 300 Pa and heating stops automatically when that lasts more than 10 s; low temperature carbonization is to use bottom heating of the combustion chamber, medium temperature carbonization may use bottom heating or alternate top and bottom heating, and high temperature carbonization is to use alternate top and bottom heating; each vertical flue is to have its own gas supply line and its gas flow is to be adjustable on its own; where a low calorific value gas such as producer gas or internally heated retort gas is used, the gas main is to carry a filter, a bypass and a steam cleaning port; and the heating system should be automatically controlled. Waste gas: flue gas ducts inside a group of retorts are to be of elevated steel pipe and those outside should be of underground concrete; the main flue is to carry

temperature and pressure detection and a gas analyser; the flue pressure signal is to be interlocked with the flue damper; and when the draught at the foot of the chimney falls below 120 Pa for 15 s the heating system is to be shut off and the low draught signal fed back to the central control room. Retort protection equipment: the base plate of the retort is to be an H section steel beam structure with steel plate not less than 10 mm thick laid over it, the plate joints being placed over the beams and welded continuously; the base plate is to be level within 5 mm and the centre of the discharge opening within 3 mm; the buckstays are to be made of H section steel; and where a tie rod passes through the bottom of a regenerator it is to be protected by a sleeve and where it passes through an H beam it is to be thermally insulated. Discharge: dry quenching is to be used, bringing the semi-coke temperature below 100 °C; the discharge equipment is to be variable speed driven and able to run in reverse; the discharge machines are to be connected in a closed way and fitted with mechanical dust extraction; and an automatic water spray should be fitted on the discharge belt.

4.7 Drying-out and start-up. Gaseous fuel should be used for drying out. The heating-up plan is drawn up so that the drying-out is divided into a drying period, from ambient to 100 °C, and a heating period, from 100 °C to 800 °C; it is based on the linear expansion data of representative samples of the silica brick used in the retort and on the temperature ratios of the various zones; the samples are taken at random from the bricklaying site as representative; the number of drying-out days is calculated on a maximum daily expansion rate of preferably 0.035 % and in no case more than 0.05 %; and the actual number of days is to be not fewer than the calculated number, the drying period preferably lasting 8 d to 12 d. On temperature management, the flue temperature is monitored and managed during drying-out and its mean value controlled to the heating-up plan, the control standard following Table 3, which sets the deviation from the plan at plus or minus 1 °C over the range 0 °C to 300 °C, plus or minus 2 °C above 300 °C to 500 °C, plus or minus 3 °C above 500 °C to 700 °C, and plus or minus 5 °C above 700 °C. Also during drying-out, the straight-line temperature, the regenerator top temperature and the small flue temperature are to be monitored and the cross temperature and the grate brick temperature should be monitored; the flue draught and the peephole pressure are to be monitored; the excess air coefficient in the drying period should be greater than 20 and in the heating period is to be not less than 2, the sampling point for the excess air coefficient preferably being at the foot of the chimney. On expansion management, the length of the retort should be measured every 2 d; the shift of the boundary between the carbonization zone and the regenerator zone should be measured every 100 °C; the curvature of the buckstays should be measured by the three-line method every 2 d; the height of the retort is to be measured cold, at 300 °C, 500 °C and 700 °C and at the end of the drying-out, with the settlement of the foundation monitored at the same time; the load on the large springs at the top and bottom of the buckstays is to be measured and adjusted once a day; the load on the small springs is to be measured and adjusted and the jack screws monitored preferably every