

CRYPTOCRYSTALLINE GRAPHITE ORE DESTRUCTION UNDER PRESSURE OF PAIRS OF POREWATER.

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Introduction

Cryptocrystalline graphite are dense rock, formed at warming up in process of carbon formation to temperatures from 700 C° to 1250 C°. Flying practically are absent, gas permeability is lowered with action of pressure, residual pores are connected with mineral spots. Mineral spots will form also slate layers, inseparable at crushing from graphite. So, graphite ore with impurity concentrations of 10–25% should be used.

Graphites have crystal structure with three dimensional ordering. On the properties they correspond to crystalline graphite - they have silvery shine, write on paper. Microstructure of cryptocrystalline graphite is formed with stratum of structural elements of platelet shape size 20 - 40 micron and on order of small thickness. Ore graphite has tendency to cracking under action of shrinkable phenomena at heating to temperature of warming and more. This reduces mechanical properties and causes self-destruction. As usual, for reception of crushing graphite are used warming up. For mechanical crushing used various crushing equipment. For thin grinding used ball mill, it permit dressing with separation fine mineral component. Mineral inclusions are mainly formed by complex oxide silicates, and chemical methods of refinement are used in addition. So fine powder of cryptocrystalline graphite ore are used for application. This limited utilization powder of cryptocrystalline graphite as a filler material in electrode industry [1].

Break for whole destruction pieces of cryptocrystalline graphite is based on it's lamellar and fine structure of pores between structural elements. It is known, that destruction of graphite foil occurs at fast heating. The same properties were fined at humidified cryptocrystalline graphite ore [2]. For fast heating pieces of ore placed in operating space of furnace with set temperature. Destruction of pieces of ore occurs by steps with secession of lamellar particles from surface (Fig. 1). Failure mechanism consists in overheating of ore to temperature of water pair, at which its pressure becomes highly than critical and causes fracturing of material. It is established that necessary temperature must be highly then 250 °C

Fracture conditions consist in task of also necessary content of pore water. At lowered humidity, and also at insufficient heating temperature at processing destruction occurs with heat in part, or is absent. At filling of pores except water filling of pores is tested with other liquids - spirit, mineral oils. This as and at humidifying, it provided destruction of pieces with full crushing and reception of particles of graphite of platelet shape hence processing with heat. Fracture process occurs from surface,

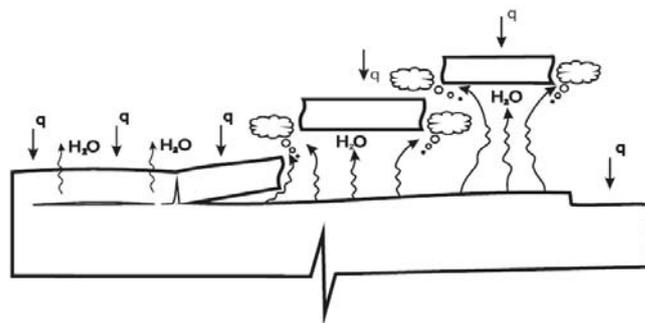


Fig. 1. Breaking of cryptocrystalline graphite with branch a lamellar particles from surface.

Near surface layer is warmed up to temperature highly than critical. Superheated steam renders pressure on walls of micropores, what results to formation of quickly spread with main crack, and also to stratum failure and secession of particle. Pressure of pairs rejects particle from piece, so newly formed surface and process is continued. At the end crushed product is formed.

Experimental

Cryptocrystalline graphite ore from the Kureika deposit with a density of 1.65–1.8 g/cm³ and an 88 - 94% carbon content of graphite was used. Dense unstrained ore pieces with no mineral layer inclusions were chosen for the rupture experiments. Failure peculiarities are shown with break on example of three experiences. So, the effects of ore piece dimensions, treatment temperature, and moisture content on the rupture of samples were determined. The moisture content of pieces was varied from <1% to full saturation. In first experience size of piece made 120 mm, humidity of 3, 6 %, furnace temperature was supported at 650 °C. In second experience pieces size ~ 50 mm humidified to 1 % and heat treated at 250 °C. In third experience specially cut out

middling's in the form cubes size of edge from 2- to 3 mm with maximum humidity (saturation water) processed with heat at 450 °C. After the rupture of cryptocrystalline graphite samples, the particle_size distribution of degradation products was determined in accordance with standard procedures. A standard set of wire screens with square cells was used. As can be seen in the diagram (see the figure), the dispersity of crushed products depends on the particle size and moisture content of the material and on process parameters.

Results and Discussion

Results of purifier of failure products are resulted on fig. 1 (number of row correspond to number of experiences).

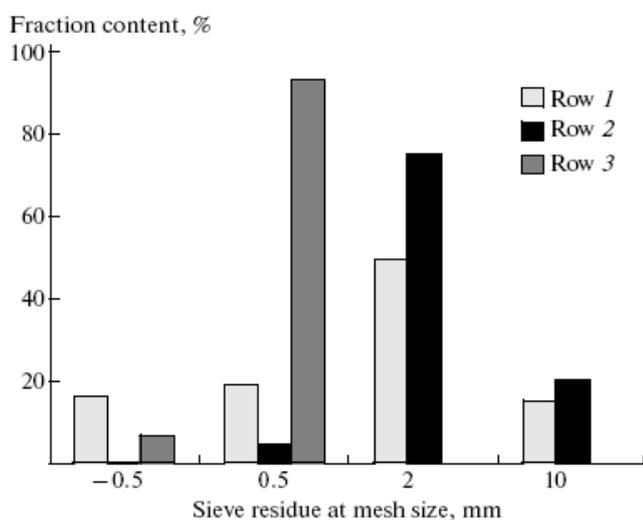


Fig. 2. Nomograph of distribution on sizes of particles of destroyed graphite

As can be seen in the diagram (see the figure), the dispersity of crushed products depends on the particle size and moisture content of the material and on process parameters.

Disintegration at a high moisture content and adequate temperature resulted in the production of fine powders; rock inclusions were not disintegrated. Small pieces were disintegrated by layer decrepitation into plates along the entire piece (experiment 3). Larger pieces (experiments 1 and 2) were degraded with the separation of flakes. Large pieces were disintegrated to a lesser extent; this was likely due to a decrease in the heating rate in the course of heating. The rupture of ore pieces began after heating to a temperature higher than 250 °C for 3–6 min or longer. The heating time

increased, as the weight of the ore piece and the working space temperature of the furnace were increased. At the same time in third experience width of plates of received lamellar particles is set with sizes of middlings. In addition bulk weight of failure products does not practically depend from particle size (table 1).

Table 1.

Bulk weight of cryptocrystalline graphite ore destruction products

| Fraction (mm) | Bulk weight, kg/m ³ |
|---------------|--------------------------------|
| -0,5 | 460 |
| +0,5 --2 | 590 |
| +2 --10 | 590 |

After rupture flakes of cryptocrystalline graphite have kind of thin plates of round form of sensibly constant thickness. Edge of plates gear, with inclined fracture surface. Surface of plates dim, rough. It is no found traces of crumpling and stratification. Anisometry of particles falls within 15 to 22 and does not practically depend from particle size. It is possible to believe that formation of particles of platelet shape is connected with schistose structure of cryptocrystalline graphite. It is possible to believe that bedded structure causes high strength along layers σ_c above durability of break across layers σ_c . Take-off of plate occurs with basis in the form square $a \times a$ and thickness d from piece of graphite at $a/d = 2\sigma_c / \sigma_a$: It is not dependent from sizes a and d . Non graphite inclusions does not rupture. The application of flakelike cryptocrystalline graphite ore particles promise to improve characteristics of carbon materials.

References

- [1] Smirnov, O.M., et al., Obogashchenie Rud (Ore dressing), 1999; 1–2:19.
- [2] RF Patent no. 2007124982, Byull. Izobret., 2009;16:726.