Influence of dispersion of coal particles on the characteristics of laser ignition

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A study was made of laser ignition (1064 nm, 120 μs) of coal particles of various grades with a size of 0.25–50 μm. The objects of study were dispersed particles of brown coal, hard coals of grade DG, G, Zh, K (Russian coal classification system) with a narrow granulometric distribution from ~ 0.25 to 60 μm. Coal samples with bulk density ρ = 0.5 г/см^3 were used.

It has been established that the dependence of the ignition thresholds H_{cr} on the particle sizes at all three stages of ignition is determined by two tendencies. First, a decrease in the particle size from the maximum values to 10 μm leads to a decrease in the ignition thresholds. Secondly, at values < 10 μm, an increase in ash content and a decrease in carbon content in the studied coal particles are observed, which leads to an increase in ignition threshold values at particle sizes d ~ 1–2 μm. As a result of the action of two tendencies, a minimum of the ignition threshold H_{cr}^{min} is formed in the particle size range 1–5 μm:

- 1÷2 μm for brown coal;
- 2 μm for coal grade DG;
- 4 μm for coal grade G;
- 0.7 μm for coal grade Zh;
- 2 μm for coal grade K.

The dependences of the ignition thresholds of coal particles of various sizes with a narrow granulometric distribution on the content of volatile matter are qualitatively similar to those obtained earlier [1, 2] for samples with a wide particle size distribution. This shows the generality of the mechanisms of laser ignition of particles of any size, taking into account quantitative threshold differences. For technical applications, it should be taken into account that the “dangerous”, easily flammable particle size range for coal grades B, DG, G, Zh and K should be taken to be the range d = 1÷5 μm.

[1] B.P. Aduev, D.R. Nurmukhametov, Y.V. Kraft, Z.R. Ismagilov, *Optics and Spectroscopy* **2020**, *3*, pp. 429–435.

[2] B.P. Aduev, D.R. Nurmukhametov, Y.V. Kraft, Z.R. Ismagilov, *Chemistry for Sustainable Development* **2020**, *6*, pp. 518–526.