CONDITIONS FOR SELF-FEEDING OF PULSED DETONATION GUNS WITH ENERGY GAS DURING GASIFICATION OF BROWN COALS BY DETONATION PRODUCTS

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Abstract: Thermodynamic calculations of the gasification of typical brown coal in the medium of a high-temperature gasifying agent (GA) are used to determine the equilibrium composition of the product energy gas (EG) at various coal–GA mass ratios, temperatures, and pressures. Estimates are obtained for the minimum mass fraction of the product EG required for self-feeding of pulsed detonation guns at various coal–GA mass ratios and gasification pressures. The dry EG obtained at a coal–GA mass ratio of approximately 0.53 and a gasification temperature of at about 2000 K (gasification pressure has virtually no effect on the equilibrium composition) is shown to possess a lower calorific value of 12.8 MJ/kg and contain about 30 %(vol.) hydrogen which ensures the feasibility of gun self-feeding: the mass fraction of dry EG required for self-feeding does not exceed 42%.

Keywords: pulse detonation gun; ultrasuperheated steam; brown coal; gasification; gasification products; energy gas; equilibrium composition; thermodynamic calculation

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Figure Captions

Figure 1 Equilibrium compositions of coal gasification products depending on the coal–GA mass ratio at different values of temperature and pressure of gasification products: left column — GA obtained by the detonation of the stoichiometric methane–oxygen mixture; right column — GA obtained by the detonation of the stoichiometric propane–oxygen mixture; (*a*) $T = 1500$ K; (*b*) $T = 2000$ K; *1* — $p = 0.1$ MPa; *2* — 1; and *3* — $p = 2.5$ MPa

Figure 2 Equilibrium composition of dry products of coal gasification at $T = 2000$ K, $p = 0.1$ MPa, and GA composition $0.281\mathrm{H_2O} + 0.719\mathrm{CO_2}$

Figure 3 Lower calorific value of dry gasification products obtained after reaching steady-state values of hydrogen and carbon monoxide concentrations at gun self-feeding with the product energy gas

Figure 4 Calculated dependences of the mass of dry EG m_{gd} and the ratio of the mass of dry EG to the mass of wet EG $m_{\mathrm{gd}}/m_{\mathrm{gw}}$ on the coal–GA mass ratio m at $T = 2000$ K and $p = 0.1$ MPa after reaching the steady-state values of hydrogen and carbon monoxide concentrations at gun self-feeding with the product energy gas

Table Captions

Table 1 Elemental composition of typical brown coal

Table 2 Model composition of coal

Table 3 Detonation parameters of stoichiometric methane– and propane–oxygen mixtures at the Chapman–Jouguet point and after their isentropic expansion to a pressure of 0.1 MPa

Table 4 Parameters of GA in six successive cycles with self-feeding of the pulsed detonation gun with the product energy gas

Table 5 Properties of dry EG for the coal–GA mixture of stoichiometric composition

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