GENERATION OF HIGHLY SUPERHEATED STEAM BY PULSED DETONATION OF THE TERNARY GAS “PROPANE–OXYGEN–STEAM” MIXTURE

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Abstract: Systematic experiments are performed to determine the concentration limits of detonation of ternary gas “propane–oxygen–steam” mixtures at normal atmospheric pressure. The experiments are made using an innovative pulse-detonation steam superheater (PDSS) with multiple cyclic detonation of ternary mixtures at various values of fuel-to-oxygen equivalence ratios (from 0.3 to 1.7) and steam volume fractions (from 0 to 0.7). In addition to experiments, thermodynamic calculations are performed. It is shown that pulsed detonation of ternary “propane–oxygen–steam” mixtures allows obtaining highly superheated steam (HSS) with a temperature exceeding 2250 K at atmospheric pressure. At the exit of the PDSS, the detonation products of the stoichiometric ternary mixture can contain up to 80% HSS and up to 20% CO_2. It is proposed to use such a high-temperature medium for the deep processing of organic municipal and industrial wastes to produce a gas mixture of CO and H_2, which can be further used as energy gas for the production of heat and/or electricity and/or as a raw material for the production of methanol and synthetic motor fuels . Due to the periodic filling of the PDSS with a “cold” ternary gas mixture, the temperature of its walls and internal elements rises only slightly, so that conventional (non-heat-resistant) structural materials can be used for its manufacturing.

Keywords: strongly superheated steam; pulse-detonation steam superheater; cyclic operation process; gaseous detonation; concentration limits of detonation; processing of organic wastes

DOI: 10.30826/CE19120410

Acknowledgments

The work was financially supported by the Ministry of Education and Science of Russia under State Contract No. 05.607.21.0304 (contract identifier RFMEFI60719X0304) “Development of effective methods of chemical inhibition of homogeneous and heterogeneous combustion processes and the creation of a demonstrator of a detonation converter of technogenic wastes” within the framework of the Federal Target Program “Research and development on priority directions of advancement of the scientific and technological complex of Russia for 2014–2020.”

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Received November 12, 2019

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