COMBUSTION OF MULTICOMPONENT MATERIALS AS A WAY OF ENERGY PRODUCTION AND MATERIALS UTILIZATION*

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With the stable growth of large cities in various countries of the world, there is an intensive increase in the volume of municipal solid waste (MSW). According to [1], in 2016, the global value of solid waste production was about 2 billion tons, of which 11% is utilized by direct combustion. According to IEA [2], in 2016 the share of generated electric energy using solid waste was 0.43% (in energy units - 108,407 GW·h). At the same time, over the past 25 years, there has been an almost continuous increase in the consumption of solid waste as the main type of fuel used for the production of electrical energy. Taking into account the data [1], 33% of the total mass of MSW are non-food waste, which can also be used as fuel RDF and SRF [3] for the production of electrical energy [4].

Nowadays, thermal conversion of MSW is one of the most effective methods of disposal with a relatively low environmental impact [5]. The most common problems of this process are the heterogeneity of the fuel composition and its technical characteristics [6], affecting the ignition temperature, stability of the combustion mode, completeness of combustion, the concentration of the formed gas-phase products [7] and the kinetics of process in general [8].

This paper presents a comparison of the results of an experimental study of the conditions and characteristics of oxidation, ignition and combustion of solid non-food waste in a thermogravimetric analyzer and a combustion chamber, the heating conditions in which are similar to real fuel-burning equipment.

Oxidation was studied by means of thermogravimetry in the temperature range 25-1000 °C at 10 °C/min heating rate in oxidizing environment. Kinetic characteristics were calculated by the Coats-Redfern method. The ignition and sequential combustion of non-food solid waste pellets was studied in experimental incinerator at temperature range of 600-800 °C using high-speed video imaging.

Sawdust and skin sample had the lowest value of the initial temperature of intense oxidation (250 and 255 °C, respectively). The shortest time of the complete oxidation process (T_f=18.5 min) was obtained for a textile sample, which is usually associated with high reactivity. The maximum ignition delay times were obtained for fabric and rubber samples (11.3 and 12.8 s), the maximum flaming combustion times – for rubber and plastic (37 and 41 s), the maximum complete combustion times – for leather and rubber (200-285 s). The time of ignition, combustion and complete burnout of samples decreased with increasing temperature of the environment up to 800 °C. A phenomenological assessment of the correlation between parameters of the oxidation in thermal analyzer and ignition in the furnace was made. The determination coefficient values of such dependences were quite low (0.40-0.65) allowing only rude evaluation. The best correlations were obtained for burnout characteristics dependences on properties of chemical reactions which could were defined by means of thermogravimetry.

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