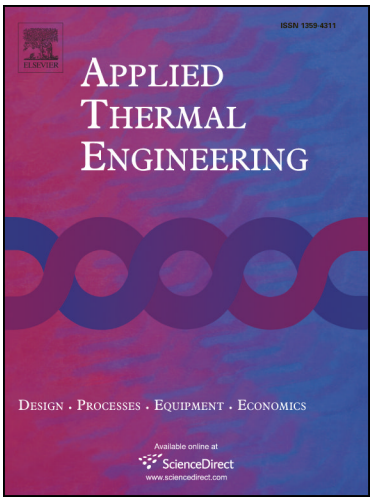

Research Paper

Ignition of coal-water fuels made of coal processing wastes and different oils

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Ignition of coal-water fuels made of coal processing wastes and different oils

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Abstract

The paper presents results of a comparison of integral characteristics for ignition and combustion of droplets of organic coal-water fuels (OCWF) made using processing wastes (filter cakes) of coals of different grade and typical liquid combustibles: waste engine, turbine oil, and fuel oil. In experiments, sizes (radii) of fuel droplets are from 0.4 mm to 1.5 mm; a temperature of oxidizer varies from 600 K to 1200 K; oxidizer flow rate is in a range from 0.5 m/s to 5 m/s. We consider the two hydrodynamic regimes of a relative motion of the droplets and oxidizer flow: a steady-state regime with droplet position on a junction of a low-inertia thermocouple and a regime of droplet soaring in oxidizer flow. Minimal ignition temperatures (significantly less than 1000 K) of filter-cake-based OCWF are reported. Study presents dependences of the integral characteristics of OCWF ignition on properties of liquid fuel components, such as, primarily, the flash point and ignition temperature. Based on experimental results, recommendations for choosing an optimal regime of combustion and a method of slag removal depending on used components of OCWF are given. Experimental data and formulated conclusions can be considered as a significant contribution to a development of OCWF technologies, which can help to solve global problems of humanity, i.e. reduction of an atmospheric pollution, global warming and dimming.

Keywords: filter cake; organic coal-water fuel; droplet; ignition; soaring.

1. Introduction

Thermal and electric energy in the world is mainly produced using fossil hydrocarbon fuels. More than 40% of the world's electrical energy is generated by coal-fired power plants [1, 2]. Prediction for worldwide electricity production [3, 4] indicates that coal consumption will increase proportional to an increase in electric power consumption. According to [4, 5], an annual world consumption of coal is about 3.9 bln tons of oil equivalent with a predicted increase in production by 2030 of more than 14% [4]. An electric power is mainly generated at the large coal-fired power plants, which use a high-grade coal with a regulated value of heat-power characteristics of an initial fuel: combustion heat, ash content, moisture content, etc. In the world, there is no mining with certain characteristics of coal (for the particular type of power equipment); thus, in most countries the coal is enriched, classified and sorted. For example, in Australia and South Africa, all produced coal is enriched [6]. Due to various coal