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decayed. The temporal evolutions of these emission spectra are found to be independent of the different mixture compositions. This may be because the breakdown gases of the tested mixtures reach to a similar thermodynamic and physiochemical state after the breakdown while having a negligible effect of species diffusion from the surrounding on the excited state quenching, which is expected from short life time of breakdown emission compared to the timescales of species diffusion.

In this presentaion, the more detail results of fuel-O_2-CO_2 mixtures with either nitorgen and helium balance will be presented.

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Plasma-Aided Processing of Solid Fuel Organic and Mineral Mass

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Currently and in the foreseeable future (up to 2100), the global economy is oriented to the use of organic fuel, mostly, solid fuels, the share of which constitutes 40% in the generation of electric power. Therefore, the development of technologies for their effective and environmentally friendly application represents a priority problem nowadays. This work presents the results of thermodynamic and experimental investigations of plasma technology for processing of low-grade coals. The use of this technology for producing target products (synthesis gas, hydrogen, technical carbon, and valuable components of mineral mass of coals) meets the modern environmental and economic requirements applied to basic industrial sectors. The plasma technology of coal processing for the production of synthesis gas from the coal organic mass (COM) and valuable components from coal mineral mass (CMM) is highly promising. Its essence is heating the coal dust by reducing electric arc plasma to the complete gasification temperature, when the COM converts into synthesis gas, free from particles of ash, nitrogen oxides and sulfur. At the same time, oxides of the CMM are reduced by the carbon residue, producing valuable components, such as technical silicon, ferrosilicon, aluminum and carbon silicon, as well as microelements of rare metals, such as uranium, molybdenum, vanadium, titanium. Thermodynamic analysis of the process was made using a versatile computation program TERRA [1]. Calculations were carried out in the temperature range 300 -

4,000 K and a pressure of 0.1 MPa. Bituminous coal with the ash content of 40% and the heating value 16,632 kJ/kg was taken for the investigation. The gaseous phase of coal processing products includes, basically, a synthesis gas with a concentration of up to 99 vol.% at 1500 K (Fig 1). CMM components completely converts from the condensed phase into the gaseous phase at a temperature above 2600 K (Fig. 2). At temperatures above 3000 K, the gaseous phase includes, basically, Si, Al, Ca, Fe, Na, and compounds of SiO, SiH, AlH, and SiS. The latter compounds dissociate into relevant elements with increasing temperature.

Complex coal conversion for the production of synthesis gas from COM and valuable components from CMM was investigated using a versatile experimental plant the main element of which was plug and flow plasma reactor. The material and thermal balances helped to find the integral indicators for the process. Plasma-steam gasification of the low-grade coal with CMM processing gave the synthesis gas yield 95.2%, the carbon gasification 92.3%, and coal desulfurization 95.2%. The reduced material of the CMM was found in the slag in the form of ferrosilicon as well as silicon and iron carbides. The maximum reduction of the CMM oxides was observed in the slag from the walls of the plasma reactor in the areas with maximum temperatures, reaching 47%. The thusly produced synthesis gas can be used for synthesis of methanol, or as a high-calorific reducing gas instead of blast-furnace coke as well as power gas for thermal power plants. Reduced material of CMM can be used in metallurgy.

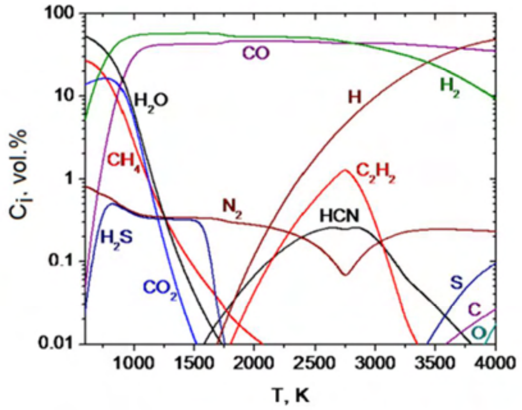

Fig. 1. Temperature dependence of the organic component concentration in the gaseous phase during comprehensive coal processing

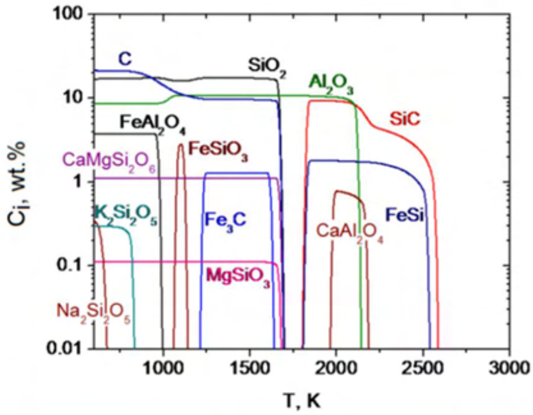

Fig. 2. Temperature dependence of the component concentrations in the condensed phase during comprehensive coal processing

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Small Scale Gas to Liquids (SS GTL)

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There is a significant worldwide demand for small-scale gas-to-liquids (GTL) modules with output capacity of up to 1,500 barrels per day for natural gas reformation, but the main limiting factor is their feasibility.

Practically all commercially available natural gas reforming technologies operate at high temperatures, high pressures, and employ a metal-based catalyst [1]. Our approach of a catalyst-free plasma assisted conversion of natural gas into high hydrogen yield syngas for small-scale GTL was discussed in detail [2].

We have searched for new solutions dealing with the Fisher-Tropsch (FT) and GTL processes and have found an alternative, which could significantly reduce capital and operating expenses for particularly small scale modules. This system is named Gas Turbine Integrated GTL [2, 3]. For the effective conversion of natural gas, the authors have proposed the employment of a recently-developed new generation of high power plasma torches.

The schematic flow diagram of the Gas Turbine Integrated GTL technological complex for natural gas processing into synthetic crude oil, using the air-methane reforming reactor with plasma assistance to produce synthesis gas with subsequent processing into the final product in the Fischer-Tropsch reactor has been developed by combining known and patented solutions of the industry experts (Fig. 1). The design with an output of 300 barrels of synthetic crude oil per day needs the following to operate: GT – gas turbine engine UGT2500 having the power of