Wrocław, 18.04.2016

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Streszczenie rozprawy doktorskiej pt.:

SPALANIE WĘGLA BRUNATNEGO W ATMOSFERZE WZBOGACONEJ W TLEN DLA BLOKÓW ENERGETYCZNYCH PYŁOWYCH

ang.: **LIGNITE COMBUSTION IN OXY-FUEL CONDITION FOR PULVERIZED COAL-FIRED BOILES**

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According to Energy Market Agency in Poland the total installed capacity in the 2013 was over 39,4 GW, where the lignite power plant represented more than 9,2 GW. Energy production from these units was 56,1 TWh whit the lignite share of 34,1 % total electricity production. Poland has several large lignite open cast mines in the amount of 14 billion Mg, and some perspective deposits with more than 60 billion Mg estimated. It is expected that operated units at the current level will cover the demand for electric energy for the next 150 years. The use of this fuel guarantees the energy security of the country.

On the other hand, energy sector is accused for the negative impact, because of exhaust gas emissions in particular CO_2, on Earth's climate. Therefore, in Europe a long-term regulations in the field of environmental protection was adopted. The European Council in October 2014 approved additional conclusions, that EU's target of reducing greenhouse gas emissions in 2030 is 40% regarding to 1990.

Technologies to reduce the negative impact of conventional fuels on the environment are mainly the technologies reducing the conventional power plant emission called clean coal technologies, including carbon dioxide emissions. Oxy-fuel combustion (in atmosphere O_2/CO_2) is a potential technology to control many pollutants such as CO_2, NO_x and SO_x. It is also one of the most promising technology applicable for existing units with retrofit. The advantages of oxy-fuel combustion are: increase the efficiency of the furnace, reducing flue gas loss by reducing the amount of exhaust gases about 80%, improved heat transfer, reducing emissions of NO_x, decrease the LOI in the ash. Therefore, an important technical problems is a development the optimal parameters for polish lignite, where some of aspects are the subject of the doctoral thesis.

The aim of dissertation was oxy-fuel combustion process analysis for polish lignite under the application oxy-fuel combustion technology in existing pulverized combustion power plant units. Combustion research with various initial moisture content in the fuel, and various O_2/CO_2 ratio of combustion atmosphere were carried out. Moreover the LOI of ash, formation and final NO_x and SO_2 emission of, and mercury retention to the ash in oxy-fuel conditions were examined.

The experimental research included: combustion and pyrolysis of coal in isothermal flow reactor; effect of particle size distribution on LOI; emissions level of pollutants (NO_x, SO_x) in the oxy and air conditions (various initial moisture content of the fuel, from W=15 to 33%), conversion rate of sulfur (S_{fuel} to SO_2). The effect of atmosphere changing from air to

oxy-combustion were carried out for oxygen ratio O_2=15%, 20%, 25%, 30% (vol.). The study also examined the problem of mercury emissions from combustion processes in the O_2/CO_2 atmosphere.

The results of the research shows that, the appropriate parameters of lignite oxy-combustion, in particular the initial moisture content, affect emission and efficient burnout. Author concludes that in air and O_2/CO_2 atmospheres the values of burnout are in range 94-98% for all tested moisture content (except W=33%). With the initial moisture content increase from W=15 to W=33% in the atmosphere of O_2/CO_2 and air, the LOI increase too, from approx. 4% to 14%. Studies have shown that the combustion of coal with a moisture content of 15% obtained the lowest values of LOI residues in ash. The NO_x emission (mg/MJ) from lignite oxy-combustion shows that for $O_2 \leq 30\%$ the NO_x is always lower than the combustion air. The amount of NO_x in the exhaust gases is highly dependent on the share of the O_2/CO_2 atmosphere, and rising with higher concentrations of oxygen. Moreover, the proportional increase of SO_2 concentration in the combustion chamber with rising share of oxygen in the O_2/CO_2 atmosphere was achieved. A very slight increase in concentration of SO_3 for oxy-fuel condition was observed. With the increase of the oxygen content in the of O_2/CO_2 atmosphere the conversion fuel sulfur to SO_2 degree, from 0.64 to 0.96 were measured. The behavior of mercury analysis shows greater, by about 10%, Hg retention in the ash in 25/75 and 30/70 atmosphere in comparison with air. Wherein the mercury ash retention in air is approx. 70%.

Presented research results provide an important conclusions, which indicates to be useful in the implementation oxy-combustion technology of Polish lignite PC unit.

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