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Summary of the PhD dissertation entitled: “Optimization of the fluid bed boiler operated in heating mode to increase its availability by taking into account the erosion process of the combustion chamber”

The power industry in Poland is based on fossil fuels. Most of them have been working since the last century, and their efficiency is much less than modern power units that were commissioned after the 2000 year. Still increasing requirements for emissions towards conventional power units, including the continuous increase in the price of CO$_2$ emission rights, make the operation of modern high-efficiency power units necessary.

The thesis concerns the operation of one of the most modern power units commissioned in 2009. In 2019, the turbine of the power unit was modernized, which made it possible to produce simultaneously heat and electricity. This modernization requires reliable operation throughout the entire heating period, so as not to disturb the heat supply to nearby cities.

The thesis presents an innovative approach to limiting the erosion of heating surfaces in fluidized bed boilers. Using modern computational techniques, such as machine learning, a neural network model was developed to calculate the temperature on the fluidized bed boiler grid. The developed predictive model makes it possible to control the temperature at the grid by changing the operating boiler parameters such as fuel and secondary air flow. The developed algorithm makes it possible to change these parameters without disturbing the fluidized bed boiler production to uniform the temperature in the cross-section of the furnace.

The uniform temperature on the grid reduces the erosion intensity of the water wall tubes in the most sensitive area, just above the refractory ends in the lower parts

of the combustion chamber. The effect of temperature uniform on erosion intensity was verified using the numerical modeling technique.

The thesis presents a detailed description of the optimization from the development of the temperature prediction model and its validation, through changing the boiler operating parameters, to erosion calculation for the real operational of the analyzed fluidized bed boiler.

The concept can be relatively easily implemented into the boiler control system, without large financial outlays.

Optimization of the fluid bed boiler operated in heating mode to increase its availability by taking into account erosion process of combustion chamber.