SUMMARY

This doctoral thesis deals with the subject of boiler flue gas treatment of nitrogen oxides (NO_X) in stoker fired boilers. The first part discusses the issue of NO_X formation, its impact on the environment and legally regulated emission standards. Attention was paid to the methods commonly used to reduce the formation of NO_X and effective methods to reduce the concentrations produced by combustion. In a further step, the issues related to emission reduction depending on the design of the power unit are presented. A WR-25 grate boiler is presented, which, equipped with a Furnace Jet Boiler System (FJBS) denitrification system based on compressed air as the motive medium for dosing equipment, was the object of experimental and numerical studies to adapt a boiler's emissions to EU requirements.

In the experimental part, laboratory tests were carried out on the injection device an ejector representing measurements of the air distribution flowing out of the device. A numerical model of the injection device was made, which, validated by bench measurements, was used to study the parameters affecting the operation of the device, including in the operating parameters of the combustion chamber. Guided by the difficulty of maintaining NO_X emission limits during maximum load operation, a boiler grate combustion model was made based on data obtained from the facility, fuel analysis and temperature measurements in the combustion chamber of the WR-25 boiler. The result of the calculations was the temperature distribution and the location of the injection of the reactant in the form of urea solution for the considered power ranges. In the next stage, field tests of the plant were carried out, where the beneficial effects of implementing an additional injection level were proven. Long-term tests proved the high variability of the temperature field distribution in the combustion chamber at peak boiler loads, requiring high flexibility on the denitrification method. Attention was drawn to the strongly nonlinear dependence of the temperature rise in the combustion chamber on boiler power above 25 MWt. Combining data from tests and temperature measurements, calculations of the temperature field in the combustion chamber were made. A comparative economic analysis of the application of the FJBS system is presented, juxtaposing it with the technology based on dosing the reactant with demineralized water.

Finally, the problems associated with a malfunctioning SNCR system, and the potential corrosion risk associated with it were presented, based on measurements and analysis performed on the WP-70 boiler.