DOCTORAL SUMMARY

Msc. Eng. Łukasz Rutkowski

entitled.: „Energy balancing of furnace chambers of medium power grate boilers - experimental and computational verification of calculation methods”

Thesis advisor:
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The doctoral dissertation deals with the issue of the application of calculation methods for the furnace chambers of large power boilers for smaller grate units.

The aim of the doctoral dissertation is to verify using the results obtained during measurements of real objects – hot water boilers fired with a grate furnace.

The work is theoretical and empirical in nature, as the measurement data were used the results from the warranty acceptance tests carried out by specialist companies and directly as records from the measuring devices of boilers from that period.

The methodology of calculating the furnace chambers is different and is based on different assumptions depending on the simplifications adopted by the authors. Some of the methods have been developed on the basis of research for large power boilers, most often pulverized ones. Hot water and grate boilers are relatively small units with a different nature of work, but the methods of determining the geometry and individual parameters of their work are based on the same dependencies. The detailed structure of the dissertation is presented below, which has been divided into two main parts.

The first part (a review) was devoted to the analysis of the literature, research issues and the results of warranty tests on WR10 and WR40 boilers (chapters 3 - 6). The boilers used in the work are characterized by a similar structure in terms of construction and the use of similar, in principle, auxiliary devices. The main difference was the thermal power produced by the boilers.

In this part of the work in chapter 4, the current state of knowledge is presented, in particular - the methods of determining the temperature at the outlet from the furnace chamber.

The second part of the dissertation is devoted to own research, and in particular to the presentation of models of analytical methodologies (Chapter 7.1-7.3) and the numerical computational model of furnace chambers (Chapter 7.4).

Chapter 8, which is the analysis and interpretation of the calculation results, compares the temperature at the outlet from the furnace chambers of real boilers with the results of analytical and numerical analyzes.

The paper shows that the Soviet normative method from 1973 for determining the temperature at the outlet of the furnace chamber, which is most often used in Poland, has a fairly good agreement with the results obtained during warranty tests of real units. However, this is not the most up-to-date edition of this methodology. Normative methods described widely in Polish literature were mainly translated from the Russian language in the 50-70s of the last century, i.e. in the period when the first and second editions of the methodology were published. The third edition, which was released 25 years later, has not been translated into Polish. It seems to be particularly important because in the available literature on the subject of temperature determination at the outlet from the furnace chamber and thermal calculations of boilers, no information has been found about the reasons for this state of affairs.

The issues of heat transfer and determination of the temperature at the outlet of the boiler furnace chamber are well known by practitioners all over the world. The introduction of new numerical techniques and the improvement of available on the market, however, proves that this is a constantly evolving field. Among the issues covered in the work, a number of possibilities for the continuation of research and development were noticed, in particular in the analysis of other types of boilers, both steam grate boilers and burner boilers fired with both solid fuels, as well as liquid and gaseous fuels.

On the basis of the obtained results, it is possible to conduct a series of subsequent, supplementary tests, allowing for the detailed database of conclusions or the initiation of a new analysis, using measurement data for other, additional boiler units.