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# 3D SIMULATION OF REACTIVE FLOWS IN COMBUSTION CHAMBERS

Educational manual

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The manual considers 3-dimensional computer simulation of heat and mass transfer processes in the combustion of Ekibastuz coal in the steam boilers furnaces, describes physical and mathematical models of this process, as well as methods for solving equations describing the three-dimensional process of convective heat and mass transfer during combustion of pulverized solid fuel, taking into account radiative transport and multiphase nature of the medium.

The manual is primarily intended for master's students of the Department of Thermophysics, Standardization and Metrology, but it can also be helpful for students, postgraduate and PhD students.

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## INTRODUCTION

The importance of simulation of convective heat and mass transfer processes in reactive environments in combustion chambers and the growing attention of the world public to such studies can be explained by the fact that with the growth of industrial production there has been a heavy increase in the amount of pollutants entering the biosphere.

Many countries, including Kazakhstan, have faced the task of regulating the quality of the environment in connection with the damage to nature caused by human activities.

In the cities of Kazakhstan, the atmospheric air is polluted with many harmful ingredients; this problem is especially pressing for the city of Almaty, where high level of pollution is caused by the total emissions from motor transport, industrial enterprises, and unique geographical conditions of the city. Among the thermal power sources, the main share of emissions falls on large sources of district heat supply: CHPP, GRES of different levels, district plants houses, etc.

About 30% of the produced fuel is used for the production of electricity in our republic, more than 40% goes to the production of heat, or almost 3/4 of fuel is used for these purposes. Participation of energy companies in environmental pollution by fuel combustion products and solid wastes is significant, and these primarily include power plants that operate on solid fuels and are the main source of air, water and soil pollution.

Heat-and-power engineering of Kazakhstan is focused on the use of high-ash coals, mainly the Ekibastuz-basin, where the low-cost coals are mined by open-pit mining. As a result of the adopted technology for the extraction of high ash coals from Ekibastuz deposit and their use without prior enrichment, the natural environment experiences significant anthropogenic impact. Most of the coal, for example from Ekibastuz, is of low quality due to high ash