Investigation of the different Reynolds numbers influence on the atomization and combustion processes of liquid fuel

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The problems of combustion are widely studied now by the scientists of the world. Increasing level of ecological pollution of the environment, reserve depletion of hydrocarbon fuel and economic growth of many countries causing increase of demand for energy - all these factors gave rise to the problem of finding of more economic and ecological way of fuel combustion. In order to solve this problem it is necessary to study thoroughly the combustion process itself and that is why the methods of numerical simulation are getting wide spread in the science. The turbulence plays great role in many devices using combustion process and its study is maybe one of the most complicated sections of hydrodynamics. It is also necessary to take into account additional factors such as various chemical reactions and radiation.

In this article tetradecone's combustion depending on the Reynolds numbers of the gas flow are investigated. Reynolds numbers of the gas flow was ranging from 2300 to 25000. As the result of the conducted numerical experiments it has been determined that at high Reynolds numbers the combustion process occurs intensively. The most effective combustion proceeds at the Reynolds number of the gas flow equal 25000, under these conditions temperature reaches values from 2001 K to 2645 K. With this value of the Reynolds number, the combustion temperature in the combustion chamber reaches maximum values and intensive evaporation of the liquid fuel drops begins. It was shown that when the Reynolds number is 15,000 and 20,000, the concentration of emitted carbon dioxide reaches the average allowable values, which are equal to $0.104823 \times 10^{-5}$ kg/kg and $0.104747 \times 10^{-5}$ kg/kg respectively.

**Keywords:** numerical simulation, combustion, two-phase flows, Reynolds number, tetradecone, modeling.

INTRODUCTION

One of the priority tendencies of the scientific and technological development of Kazakhstan is the research of simulation of formation of polluting fog and their dispersion in the atmosphere. This problem has a great value because of the increasing concern for the ecological situation in Kazakhstan as the atmospheric air in the cities of Kazakhstan is daily polluted by different hazardous substances (NO₂, CO, CO₂, soot and so on) [1-5].

For the recent years the dispersion of the liquid sprays in the neutral atmospheric flows has been well studied by means of numerical, laboratory and natural researches. In these researches the main attention has been given to the dispersion of chemically reactive scalar admixture in the free convective flows.

As a matter of urgency, the use of liquid fuels can be said that over the past few years 60 million passenger cars have been produced, that is, 165,000 vehicles are produced per day. The engines of the current generation are significantly different from those used a few decades ago. The main combustion process in engines remains the same, but the types of injections differ significantly. For example, modern engines with electronically controlled injection systems, along with air compression mechanisms that help improve the combustion process, use only the required amount of fuel. More than 50% of cars are produced in Asia and Oceania, while Europe produces almost a third of the total number of cars in the world. In the last decade, the total number of cars produced per year has increased by 20 million, which leads to a high growth of pollutants that pose a greater threat to the environment [6-11].

The regulations on emissions of pollutants are becoming more and more severe over time, for example, until 2025, due to world-wide established ground rules, it is planned to reduce CO₂ emissions from passenger cars to about 100 mg per km. It is known that the International Energy Agency (IEA) has been tasked to use renewable energy sources as an energy carrier by 2050 and to reduce CO₂ emissions to the atmosphere by half as an indicator of harmful substances [12-14].

Although carbon dioxide is not a toxic gas, it still represents a danger to the environment due to...