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Kiev, Ukraine

Abstract Book

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EFFECT OF CHANGING OXYGEN CONCENTRATION ON FORMATION OF AIR-FUEL MIXTURE IN AVIATION ENGINES

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SUMMARY

The effect of air composition on the formation of a stoichiometric fuel-air mixture for combustion in aircraft engines is showed. A method for increasing the efficiency of burning aviation fuel, based on the actualization of information on the current concentration of oxygen in the atmosphere is proposed.

Keywords: air-fuel mixture, jet engine, oxygen, chymotology

One of the main tasks in the design and operation of aircraft engines is complete and reliable combustion of fuel. i.e. they must ensure the formation of stoichiometric air-fuel mixtures. In Fig. 1 shows the factors that affect the combustion process.

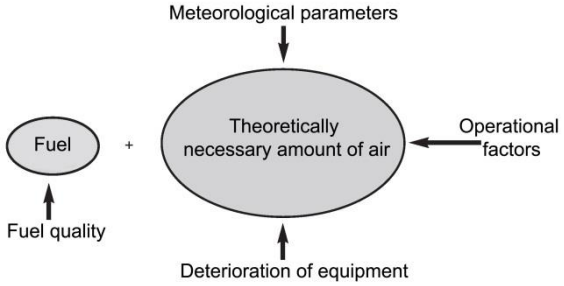

Fig.1. Factors of influence on the combustion process

The actual composition of the fuel mixture in engines is usually different from the stoichiometric. It is customary to characterize the coefficient of excess air (α), which is the ratio of the actual mass of oxygen in the mixture to the stoichiometric one [1]. Combustion of fuel with a large value of α leads to significant energy losses, which has a significant effect on performance, for example, on the duration of flight.

The coefficient α is an important energy characteristic of the fuel combustion process. It is determined by the amount of unburned oxygen in the air. Consequently, the component composition of the air used for combustion is important [2].

In previous work [3], a noticeable effect of the current oxygen concentration on fuel combustion at communal and industrial heat power plants is showed. Also showed the effect of changing the meteorological parameters not only on the seasonal dynamics of fluctuations in oxygen concentration, but also on the daily. The effect of meteorological parameters on the partial density of oxygen in air on flatland is experimentally confirmed in [4]. The authors propose a functional dependence of the current oxygen concentration in the air on the meteorological parameters:

$$[O_2](P,T',\varphi) = 20{,}957 \cdot \left(1 - \frac{e(P,T,\varphi)}{P}\right), \quad (1)$$

where $[O_2]$ – functional dependence of current concentration of oxygen in the air, %; P – atmospheric pressure, hPa; T – temperature of air, °C; φ – relative humidity, %; e – functional dependence of partial pressure of water vapor, hPa.

The authors propose to take into account the current concentration of oxygen in order to increase the efficiency of combustion of aviation fuels (α). To confirm the hypothesis of a change in the partial density of oxygen at different altitudes under different meteorological conditions, it is necessary to conduct parallelelar measurements with special gas analyzers and meteorological measuring instruments using balloons, unmanned aerial vehicles or other flying devices.

The actual information on the composition of air during the flight of an aircraft can be used in forecasting the quantity and the quality of fuel consumed and for improving an automated control system for burning fuel by aircraft engines. The application of this approach will reduce the amount of unburned fuel without compromising the environment.

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