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Evaluation of jet engine emissions using conventional and alternative fuels

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Modern air transport sector is developing constantly. Transport is powered by petroleum that supplies 95 % of the total energy used by world transport. Nowadays civil aviation relies predominantly on kerosene aviation fuel, known as jet fuel. Along with the situation in exhausting of crude-oil deposits, the state of environment causes a special concern. The world transport energy use is projected to increase at the rate of about 2 % per year, energy use and carbon emissions is projected to be about 80 % higher than current levels by 2030.

The abovementioned factors have caused recent interest in the development of aviation fuels produced from alternative sources. Today scientists work predominantly on developing of renewable JFs (fuels, which are produced from renewable feedstock – plant oils, fats, starch or sugar containing plants, organic waste, algae etc) and improving its properties.

For obtaining blended JFs we have used bio-additives, which are fatty acids ethyl esters (FAEE) of rapeseed oil that were produced in the Institute of bioorganic chemistry and petrochemistry of the National Academy of Sciences of Ukraine and were specially modified by vacuum distillation according to the method developed by the authors during previous researches. Blended JFs were obtained by mixing conventional JF and bio-additives in quantity 10 % (v/v) and 20 % (v/v).

For fulfilling bench tests the gas-turbine engine of model RU19A-300 was used. The bench tests were fulfilled on certified engine-test base with specific stand at State Enterprise 410 factory of Civil Aviation (Kyiv, Ukraine).

In the result of emissions evaluation it was concluded that blending conventional JFs with bio-additives allows improving its environmental properties: EI of CO_2 in exhaust gases was decreased by ~2%; EI of H_2O in exhaust gases was decreased by 4%; EI of SO_2 in exhaust gases was decreased by 14% and EI of NO_x in exhaust gases was decreased during take-off regime by 6%, during climbing regime by 7%, during approaching and landing regime by ~17% and during taxi/idling regime by ~17%.

The receipts of new JFs blended with bio-additives, which possess improved exploitation and environmental properties were developed. According to developed receipts JF blends may contain 10%, 20% and 30% of modified FAME or modified FAEE bio-additives. In a result it was proved that application of bio-additives derived from rapeseed oil in jet fuel reduce exhaust gases emissions from jet engine.