ASSESSMENT OF THE POSSIBILITY OF BOOSTING A TURBOSHAFT ENGINE FOR UAVs THROUGH WATER INJECTION INTO THE COMBUSTION CHAMBER

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The takeoff performance of helicopter-type UAVs at high altitudes is limited by the reduction in gas turbine engine (GTE) power due to:

1. The rarefied atmosphere.
2. The need for increased engine power due to the rise in required power for the rotor system of the helicopter-type UAV.

This significantly limits the payload capacity at high altitudes or necessitates a rolling takeoff (airplane-style) where the UAV gains speed before liftoff.

As the flight speed increases at a given altitude, the required power initially decreases and then increases. However, with increasing altitude, the required power for takeoff also grows. At an altitude of 5 km, the required power differs from the baseline (at H = 0 and M = 0) by nearly 30%. The power output of the GTE also decreases significantly with altitude.

If the engine can be temporarily boosted – just long enough for the helicopter-type UAV to gain speed and thereby reduce the required power for flight – this allows for the transportation of a greater payload.

It is proposed to achieve engine boosting by injecting water into the combustion chamber of the GTE. Such boosting methods are already being developed for land-based gas turbines, including in the STIG (Steam Injected Gas turbine) cycle. This results not only in an increase in engine power but also an improvement in efficiency.

To evaluate the potential of this type of engine boosting, a mathematical model developed at the National Aerospace University "Kharkiv Aviation Institute" (KhAI) is used.

The calculation results are presented in Table 1.

Table 1 – Dependence of the amount of water required to achieve the necessary engine power at different flight altitudes

Flight Altitude (km)	Engine Power Loss Factor	Required Relative Power at Full Load	Relative Water Mass Required to Provide Takeoff Power (kg/s·MW)
0	1	1	0
2	0.853	1.12	0.387
3	0.797	1.17	0.586
4	0.741	1.22	0.747