

ENVIRONMENTAL THREATS AROUND AIRPORTS AND POSSIBILITIES OF LIMITING THEM

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Abstract

The article has presented some of the most important reasons for and sources of main factors causing interferences with the natural ecosystem within the airport zone- resulting from particularly heavy traffic and from the functioning of various devices on small limited areas of surface and the ground-level layer of the atmosphere. These operations are accompanied by intensive noise and heat emitted in large quantities- which are caused by the work of jet engines of taking off and landing aircraft. The jet engines work contributes to the 'production' of not only CO₂ and H₂O, but also numerous harmful chemical compounds such as CO, HC as well as NO_x.

Key words: ecology, toxins, airport traffic, aircraft take- off, turbofan engine

INTRODUCTION

The degree of the pollution of the airport environment depends on the effects of the functioning of airport equipment and on all of the ground services responsible for assuring the aircrafts' safe landing, the passengers and cargo off load and further transportation outside the airport, also the most noticeable (noise!)- of the running engines during airplanes take-off and landing.

Among some of the airport's ecosystem disruptions are:

- ground-based: electromagnetic radiation(radars, transceivers); chemical agents for washing and de-icing aircrafts, runways and taxiways ; fuel and oil spills; raising dust; noise and exhaust fumes made by moving vehicles

-aircraft: vast amounts of exhaust gases and several times bigger amount of air from engine secondary stream with high speed are entering the environment. Intaking air-mass around the aircraft damages the airport surface. The turbulent air circulation caused by running engines not only depletes the soil surrounding runways and taxiways, but it is also a source of exhausting noise for living creatures.

1. AIRPORTS AS SOURCE OF ECOLOGICAL THREATS

The intensity of emerging ecological threats at airports substantially depends on the organization of work and activities ensuring full safety of taking-off and landing airplanes, transfer related with loading and unloading passengers and their luggage (or cargo); maintenance before and after the flight; cleaning and refueling etc.

What is more, these operations require the use of numerous machinery and special equipment (including tractors and motor-cars). All of them must comply with formal requirements of environmental protection with the minimization of energy-consumption. Nonetheless, these devices are a source of noise, and also, as they are equipped with piston engines, they release hot exhaust gases with toxic components such as NO_x, CO, HC and large quantities of CO₂. One must bear in mind that this comprises a scintilla of the emissions produced by jet engines of landing and taking-off airplanes. Their concentration at one place poses a major ecological threat for nearby people.

It has to be noted that to produce 1 hp from piston engine requires 1 g/s of air and engine is emitting one g/s of exhaust gases.

To minimize the amount of exhaust gases, the aim is to replace spark-ignition engines in airport vehicles and devices with more effective self-ignited ones, and in long-term electric engines.

The view that exhaust gases (with the poisonous content) are the cause of asthma, lung and liver illnesses, also various types of cancer is becoming common among medical and sanitation institutions.

Probably 80 millions Europeans live in the airports neighbourhood so they are exposed to unhealthy noise.

2. AIRCRAFT AS A SOURCE OF ECOLOGICAL THREATS

Majority of combat and commercial aircraft are powered by jet engines which are the main contributors to the atmosphere pollution.

It has to be stated that contemporary turbofan engine represent the highest form of art among the technical products and consist of the newest technological, material engineering and electronic achievements and contribute to development of these scientific disciplines.

The level of development of jet engines can be described by Thrust and Specific Fuel Consumption (SFC). In the forties of the last century jet engines had a thrust of approximately 800 daN and SFC around 1kg/daNh whilst now the thrust is almost 50000 daN and SFC approaching 0.28 kg/daNh which means 60 times higher thrust and five times better economics. Such achievements are not for free and for example in the nineties of the last century 1 daN cost was around 200 \$ when at present nearly 700 \$.

Although participation of aviation in the total mankind green gases emission range from 2% to 3% it has to be pointed out that pollution concentrates on limited areas.

During the first three minutes of a commercial aircraft take-off and climb, the airflow around the aircraft of approx. 200 k cubic meters accelerates to 300m/s and the stream of exhaust gases of approx. 50 k cubic meters accelerates to 600m/s, simultaneously generating nearly 2000 kg of CO₂, creating a massive turbulence of the air at runway zones and their spatial extensions. Whereas during descent and landing, atmosphere disturbances are much lower but persist significantly longer so they have to be equally considered when their negative impact on airports zone is discussed. Aviation operations are a significant nuisance for airports neighbourhood inhabitants due to the frequency and intensity of noise as also the presence of polluted air. The degree of problems caused by aviation within limited area of airport zones can be exemplified by the Chopin Airport with the average of 400 daily aviation operations. The interval between them is only few minutes and, what is important, they occur mainly in two peaks, in the morning and afternoon.

3. CLOSING REMARKS

Although it is obvious that the described aviation difficulties, are well-known for numerous years, new problems occur - as the fast growth of civil aviation consequences in its social and ecological „noticeability“.

It results in the formulation and introduction of new rules such as acceptable limits of noisiness of taking-off and landing airplanes and permissible toxic contents in exhaust gases

All of the above mentioned look like „shots to one goal“. Improvements in this field can only be reached as a result of specific engine modifications. However, these improvements which enable the reduction of fuel consumption by introducing new materials allowing the increase of temperature before the turbine as well as the pressure ratio are causing significant increase of NO_x emission. Some modifications like the usage of biofuels and other alternative fuels significantly reduce the loss of CO₂ equilibrium in the atmosphere and limit the amount of pollutants in exhaust gases. It is believed that utilization of shale gas or pure hydrogen, even ethanol and methanol is a solution. In these cases, balance must be maintained during their production process with the amounts of carbon consumed, for e.g. evaporation.

It seems that the easiest way to reduce the noisiness of jet engines could be achieved by modifying the shape of exhaust nozzles or by introducing ejectors of additional airstream from the atmosphere.

Every change requires thorough examination (various flight conditions and engine operating ranges), and especially the design engineers' profound knowledge and intuition in thermodynamics, aerodynamic and fluid mechanics.

As experience teaches, there are cases in which reducing an adverse behavior of the machine in one operating mode resulted in a dangerous increase in another.

Therefore, any success in this field can be expected only after an insightful evaluation of the current state and the chances of (for e.g. technological) its improvement.

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ZAGROŻENIA EKOLOGICZNE WOKÓŁ LOTNISK I MOŻLIWOŚCI ICH OGRANICZANIA

Streszczenie

W artykule przedstawiono najważniejsze przyczyny i źródła głównych czynników powodujących zakłócenia „normalnego” systemu ekologicznego w strefie lotnisk–a wynikające ze szczególnie intensywnego ruchu i działania różnych urządzeń na niewielkim obszarze powierzchni ziemi i przyziemnej warstwie atmosfery. Działaniom tym towarzyszą skoncentrowany hałas i wydzielanie ciepła w ogromnych ilościach–których przyczyną jest praca turbinowych silników odrzutowych startujących i lądujących samolotów. Z pracą tych silników wiąże się „produkcowanie” nie tylko CO₂ i H₂O ale także wiele szkodliwych związków chemicznych jak CO, niespalone HC oraz NO_x w dużych ilościach