ECOLOGICAL ASPECTS OF AIR TRAFFIC TECHNOLOGY.

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Abstract: Rapid growth in air traffic, increase operating distance and flight altitudes significantly affects the quality of the environment. It is currently still greater attention to problems associated with emissions of aircraft engines. Aircraft engines, like any other device of the same principle, produce pollutants that have a significant impact on the operating conditions of living processes on earth.

K e y w o r d s: air transport, ecology, environment, noise of air traffic, emissions of air traffic, the plume, smoke aeroengines, components of the exhaust gases, greenhouse effect.

1 INTRODUCTION

In few areas of human interest can be recorded within a short time the last two decades that increases the attention of science and practice related to air transport, as with environmental issues. In a very short period of relatively marginal problem has created a significant problem in some areas of the world even critical. Currently, the ecology receives priority status, is one of the global problems of humanity and its significance begins to exceed the economic and political components of the development of human society. Very often we encounter the environmental assessment of social and even economic problems, the greening of science, social and technical disciplines.

The concept of ecology can be understood from different aspects and therefore there is no single universally applicable definition. The Dictionary of the school and the practice of p. Maria Ivanova Šalingovej, term ecology is defined as follows: "Ecology is the science that studies the relationship between organism and environment and environmental protection. The environment in the broadest sense is understood as everything that surrounds us and where we live in an environment which allows the creation of expression and function of living organisms. It is a set of conditions in which biochemical processes take place for all living substances, and therefore they affects not only humans but all living organisms in the nature.

Global environmental problems all over the world are paid more and more attention. However, there are different opinions later, what the problems are global and what the order of their importance is. Leading world experts agree that there is a need to address in particular the following problem areas: raw material and energy security, population growth, terrorism, food sufficiency, the process of urbanization and migration, population, greenhouse effect, elimi-nating hunger and poverty and the environment.

Threatening the social implications of population growth, the population of the globe. Only recently reached the magical world population 7 billion people, with about 60 % of the world's population lives in Brazil, Mexico, India, Bangladesh, Pakistan, Indonesia, Nigeria and China. In connection with this trend has already started the largest "Migrations" from rural to urban areas. In developed urban areas is necessary to solve many problems related to supply the region with drinking water and food, the availability of health services, waste disposal, energy supply and air pollution.

In some areas of the Earth's ecological crisis occurs in the true sense. One of the reasons for the gradual and continuous deforestation of tropical rainforests might adversely affect the climate on the whole planet.

The forests of the northern hemisphere are again exposed to the huge amount of emissions, which are mostly plant sources, nuclear power plants and domestic heating. A significant proportion of these emissions come into contact with precipitation, which is due to the increasing content of sulfur and nitrogen oxides in the atmosphere strongly acidified in the form of acid rain severely affecting the soil and vegetation.

Above the cities or industrial centers, in addition to emissions deterioration of air quality and smog contributes to a diverse mixture of pollutants in the atmosphere, mainly ash, smoke, fog and imperfectly oxidized organic matter. By burning fossil fuels, which are currently on earth receives a substantial amount of energy, but the air in addition to sulfur and nitrogen oxides also receives large amounts of carbon dioxide (CO_2),

causing the average temperature increase on Earth due to greenhouse effect.

The major ecological problems of the globe should also mention the maintenance of ionized oxygen layers in the upper atmospheric layers cover the planet - in the stratosphere. There are oxygen exposure of the ultraviolet spectrum of sunlight gradually converted to ozone. As a result of the shrinking of oxygen, however, produces a small amount of ozone. Ozonosphere layer, which is of great importance for life on Earth (to protect the biosphere from cosmic and ultraviolet glow-it), is a thin, yet increasingly threatened by human activities. Threats to Earth's ozone layer in the past and ongoing operation of supersonic aircraft Concord, which for that very reason have ceased operation in 2008. Currently, the airline passenger, cargo and mail don't use supersonic aircraft.

The growths of air transport in addition to positive and bring a range of negative effects particularly on the environment. Aviation in a relatively short period of rapid development has passed. Increasing the number of take-offs and landings, the number of airports, the production of larger and faster aircraft, although efficient, flying long distances, building infrastructure, the problem of environmental pollution is becoming a highly topical. Many experts who are dedicated to research, the harmful effects of air traffic on vegetation and climate of the planet's claim that our knowledge is still not sufficient for binding to assess this impact due to lack of analysis, experimentation and legislative measures. Still does not clearly say how much and what substances are released into the air aircraft engines. Only some of the pollutants emitted no doubt, as such. nitrogen oxides, carbon monoxide and unburned hydrocarbons. They argue that what is happening today in the boundary layer between the troposphere and stratosphere at about 10 km altitude above the ground is worse than anything else to cause adverse effects on vegetation of the planet. There is no doubt that aviation contributes its share to the greenhouse effect and global warming on the earth not only the production of air pollutants as well as harmless water vapor.

The future is therefore in relation to environmental protection necessary to minimize adverse impacts on air traffic environment, in particular aircraft noise and emissions from aircraft engines, new technologies, operating procedures, more efficient air traffic management, work organization, development of alternative fuels (jet fuel from renewable resources as a result of high oil prices and limited supplies), the introduction of stricter standards for emissions (legislation), construction work, a suitable arrangement of the subsystems and the airport.

2 AIR POLLUTION AND AIR TRAFFIC

Rapid growth in air traffic, increase operating distance and flight altitudes significantly affects the quality of the environment. It is currently still greater attention to problems associated with emissions of aircraft engines. Aircraft engines, like any other device of the same principle, produce pollutants that have a significant impact on the operating conditions of living processes on earth. The influence of these conditions manifested directly and indirectly to air pollution exposure on the physic - chemical state of the upper layers of the atmosphere.

Air traffic is becoming an increasingly important atmospheric pollutant. In the vicinity of major civil airports are produced by three basic components of air pollutants without specifying the order of priority.

- The plume arising from the take-off and landing aircraft containing harmful and polluting substances (gases, soot, particulate matter, which gradually fall on the ground),
- Odour which are inherent in the plume, accompanied by basic runway at a great distance,
- The fog that reduces visibility and occurs near the airport with enhanced operation with full.

The intensity of all three components of atmospheric pollution depends largely on the meteorological conditions in the vicinity of airports. Very unpleasant and damaging the microclimate near the hangars and aprons areas where there is a technical clearance of aircraft and where the lack of conditions for the flow of atmospheric air of large air pollution and overheating in the breathing zone of people (technical staff and passengers). This finding is also one of the constraints to solve

capacity problems at airports by increasing the throughput of today's airport infrastructure expansion method.

The large air pollution occurs in the tests and aircraft engines. Transferred to the introduction of aviation technology in operation, whether new or after repair of aircraft engines, which is the responsibility of technical staff to test all modes of aircraft engine.

Today, as a fuel in aviation turbine engines use kerosene produced under the designation JET A1, also kerosene and such production of aviation fuel Avgas 100 LL labeled with piston engines. Kerosene Jet A1 is 2nd class flammable substance . It is a liquid mixture of hydrocarbons boiling at 150 to 300 ° C. Ignition temperature is 220 ° C, flash point about 38 ° C. At 20 ° C kerosene is a clear colorless liquid, water and mechanical impurities. Kerosene is specific in that in order to prevent corrosion of the lapped part of the regulatory function of the engine is almost sulfur free. The actual process of burning in the combustion chambers is highly effective, up to 20 times more effective than the equipment used for oil. The combustion chamber of the engine air-fuel combustion in a perfect turn from 98 to 99 % of carbon dioxide and water. These combustion products are environmentally benign.

Kerosene in general is a clear liquid hydrocarbons on the basis of density with a density of 0.78 - 0.81 g/cm3. It is obtained from the fractional distillation of crude oil in the temperature range 150° C to 275 ° C. Hydrocarbon chain consists of a metal number 6 to 16 carbon atoms in the molecule. The main components of kerosene are dihexyl, alkylbenzenes, naphthalene and their derivatives. The flash point of kerosene is 37 to 65 ° C and the ignition point is 220 ° C.

3 AIRCRAFT ENGINES AND SMOKE ESSENCE CREATION OF SMOKE

Working vane air motors is accompanied by the formation of harmful substances that act on the motor output in the form of smoke. Smoke-gas is associated with the formation of coagulated unburned hydrocarbon molecules containing more than 95 % of carbon, acting as soot from the engine. Soot formed in areas with a rich mixture at high temperatures. May arise in any area of combustion in the combustion chamber, where there is speed mixing fuel and air inadequate or there is insufficient oxygen. The combustion chamber of a fuel nozzle swirl chamber with a central area of the flame soot. In this area there is back flow of gas towards the fuel spray, and therefore involves the burning of the local lack of oxygen. These areas are places of soot. Most of the soot, which originated in the primary combustion burn. Unburned carbon black, leaving the engine with other gases. Therefore, in terms of soot combustion can be divided into two areas. In the first blacks to create the second and most of them burned. In doing so, the burning of carbon black is significantly less than the rate of burning fuel and therefore blacks need to burn your longer stay in the combustion chamber.

4 FACTORS RESULTING IN FORMATION OF SOOT

The basic factors affecting the formation of soot, including:

- the composition of the fuel mixture preparation,
- pressure, temperature of air entering the combustion chamber

Preparation of fuel - air mixture and the organization of its combustion in the combustion chamber contribute to the formation of soot. Formation of soot and smoke of aircraft engines depends on the pressure in the combustion chamber, the pressure increase accelerates combustion. A small air pressure areas, rich fuel mixture in the vicinity of the nozzles are not capable of combustion and thus do not contribute to the formation of soot. With increasing pressure increases reactivity of these areas and the combustion area extends towards the fuel nozzles, i.e. to the rich mixture. Fuel here is not completely evaporated, and the growth pressure is exacerbated by its evaporation, thereby adversely affecting the production of fuel - air mixture. Increasing the gas temperature at the outlet of the combustion chamber causing more combustion soot and thus reduce the smoke.

With the growing pressure for the compressor is reduced vigorousness jet fuel and thereby prevent the formation of a homogeneous mixture, which again contributes to the growth of soot.

This can be avoided by using evaporative fuel system. The reality is that smoke always reduces the combustion efficiency, but this reduction is very small (less than 0,5 %).

5 EXHAUST GAS COMPONENTS

The aircraft engine emissions, according to statistics, more than 200 different compounds. It is anticipated that a further more than 50 kinds of compounds is not yet precisely identified.

Carbon monoxide (CO) is formed in the combustion chambers for two reasons, in the primary combustion fuel (in the heart chambers), due to rich mixtures when the air excess coefficient $\alpha > 1$, i.e. there is a lack of oxygen for complete combustion. Carbon monoxide also occurs in the secondary combustion, where oxygen is not enough, but α is close to one. Fuel combustion in α near one of the primary high temperature at which carbon dioxide CO2 decomposes into carbon monoxide CO and O_2 oxygen. This reaction is endothermic - heat consumed.

Formation of CO during combustion always reduces the combustion efficiency and specific fuel consumption increases. If the combustion chamber is long enough, CO burns and its concentration in emissions will be small. The concentration of CO will decrease with the increase in the length of the combustion chamber, with the growth of perfect mixing of fuel and air as the growth temperature at the entrance to the chambers.

Unburned hydrocarbons are drops of fuel that passes through the combustion chamber without being burned, and decomposition of hydrocarbons in fuel hydrocarbons, lower molecular weight, such as methane, acetylene, etc.. The existence of unburned hydrocarbons is a source of unpleasant odors are caused by evil consists of a mixture in the combustion chamber. The concentration of unburned hydrocarbons in the gas output will be the lower, the higher the temperature and pressure of air entering the combustion chamber. Unburnt hydrocarbons reduce combustion efficiency.

Nitrogen oxides result from the oxidation of atmospheric nitrogen. Oxygenation takes place at high temperatures in the combustion chamber at temperatures higher than 1800 K. Nitrogen oxides formed in combustion chambers of the heart. Doing so can lead to two types of reactions:

$$NO + O_2 \rightarrow NO_2 + O_2$$

or

$$NO_2 + O \rightarrow NO + O_2$$

The first reaction is a process of "disappearance" of nitrogen and the other is a process of "restoration" of NO, because NO molecules can react again with oxygen. Reduction of nitrogen oxides during combustion of fuel in the combustion chambers of aircraft engines is one of the key requirements of today. The solution would be to manage a stable combustion chambers in the $\alpha > 1$, thus the combustion chamber that originated in the very hot core.

Sulphur compounds are very dangerous not only part of the emissions of aircraft engines and can be removed by separation of sulfur from diesel fuel at the refinery.

Water vapor and hydrogen peroxide to the stratosphere, although somewhat dangerous, but at present it is harmful negligible.

The composition and concentration of harmful emissions varies with engine operating mode. Effect of engine speed with a fixed geometry of the composition of the emissions is shown in the graph.

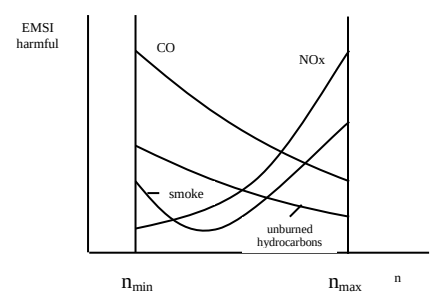

Fig.1: Effect of the composition of engine emissions

The following table lists the applicable standards for some pollutants from the operation of aircraft engines.

Table: 1

Standard [%]	SVK	USA	Russia	ICAO

oxides of sulfur	0,05	0,3	0,1	0,04
carbon monoxide	0,3	no	0,5	0,2
unburned hydrocarbons	0,12	no	no	0,09
small particles of carbon	0,18	no	0,25	0,138
nitrogen oxides	no	no	no	0,8

Legend**:** no* - a standard that does not value the low incidence

6 CONCLUSION

All these harmful emissions, thus they are toxic, they can directly or indirectly adversely affect the nature and population. In addition, emissions of nitrogen oxides and hydrocarbons when flying at altitudes above 10 km increases the absorption of infrared radiation, which can affect the climate. Air traffic consequences of their negative impact on air quality. However, taking into account the fact that air travel today, annual traffic of more than 2.5 billion people in connection with the fact that nowadays, the ecology of aviation pays considerable attention to the real action, this risk is acceptable.

Currently on the land and beyond the level of experts in this area under discussion on the creation of joint ventures 'Clean Sky', given the projected growth in air traffic to double over the next 20 years. This project aims through innovative technology to reduce the environmental impact of air transport, supporting research and development aimed at developing a new technology called. "Green aircraft". An important aspect is yet to agree a joint action by all interested organizations, groups and committees at national and international level, international organizations and political bodies.

Under the "Clean Sky" is the emphasis placed on creating innovative air traffic system based on the integration of advanced technologies and models are indeed size to reduce noise and gas emissions and improve fuel efficiency of aircraft. The basic portfolio for the implementation of "Clean Sky" will be called six technical areas. Integrated Technology Demonstrators (ITDs), which will conduct tests and experiments in real environments. ITM is defined as follows:

- ITM aircraft Smart Fixed wing (active wing technology)
- Green Regional Aircraft ITD, (easy to configure and Technology)
- Green Rotorcraft ITD (innovation rotor blades, reducing noise and drag)
- ITM sustainable and green engine (technology, low noise, high efficiency, low NOx, open rotors or intercoolers)
- ITM Systems for Green Operations, (all electric aircraft equipment, new aircraft systems architecture, green routes)
- ITM environmental design (durability of materials and components, energy, emissions and recycling)

BIBLIOGRAPHY

[1] PRUŠA, Jiří a kolektív: Svet leteckej dopravy, 2008. 321 s. ISBN 978-80-8073-938-6
[2] SABO, Stanislav: Riadenie leteckej dopravy
[3] KAZDA, Antonín: Airport design and operation,
[4] http://www.icao.int (Annual reports of the Council)
[5] http://www.letecképalivá.cz
[6] ŠIŠKA, František: Ochrana ovzdušia.

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