Альтернативні палива – необхідність майбутнього авіатранспорту

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На сучасному етапі найбільш поширеною технологією рухомих установок у сфері комерційних авіаперевезень є газова турбіна (як турбореактивний двигун, турбовентиляторний двигун або турбогвинтовий двигун), яка наповнюється керосином. Ця технологія зараз є відносно передовою. Авіаційна промисловість протягом останніх десятиліть досягла суттєвих результатів у сфері енергозбереження, однак вони переважно обмежувалися вдосконаленнями в межах уже наявних технологій і супроводжувалися операційними розробками на зразок керування повітряним і наземним транспортом в аеропортах. Незважаючи на ці досягнення, глобальне зростання повітряного транспорту призвело до значного збільшення споживання нафти та викидів парникових газів, спричинених авіатранспортом. Згідно з різноманітними дослідженнями авіатранспорт продовжуватиме стрімко розвиватися і в майбутньому. Оскільки наразі не існує альтернативи газовій турбіні, предметом запропонованого дослідження є альтернативні палива й альтернативні джерела палив. Інші проекти вивчають можливості енергозбереження шляхом передових аеродинамічних технологій, використання нових матеріалів або зменшення ваги. У всіх випадках головною метою є зниження викидів парникових газів та інших забруднювачів шляхом покращення ефективності рухомої установки загалом. Авіатранспортна промисловість сьогодні сконцентрована на трьох проблемах: вартість палива, оподаткування викидів і натиск конкурентів. Більшість експертів стверджує, що газові турбіни, які працюють на основі органічного авіапалива, залишатимуться важливою технологією авіатранспорту в недалекому майбутньому. Проте кілька альтернативних варіантів все ж є. Кожен з них має власні унікальні переваги, хоча жоден не пропонує найкращого вирішення проблеми.

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Alternative fuels – necessity for air transport of tomorrow

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This paper deals with the importance of alternative fuels in air transport. Past energy crisis have arisen but were then laid aside as additional oil reserves became available and prices dropped. But now the problem of decreasing supplies and permanently rising prices is joined with global climate change. These factors together create an argument more compelling than it was a decade ago for reducing the dependence on fossil fuel.

Keywords – fuel, engine, air transport, synthetic liquid fuel, fossil fuel, bio fuel, ethanol, hydrogen

I. Introduction

Since the start of the jet age, aviation has improved fuel efficiency by some 70% through enhancements in airframe design, engine technology, airline operations, airspace and airport capacity as well as rising load factors. More than half of this improvement has come from advances in engine technology. Aviation consumes 2% of all fossil fuels burnt. This represents 12% of the fuel consumption of the entire transportation sector, to be compared with 80% dedicated to road transport. The three main factors are responsible for the current development on alternative fuels:

- Expected phase-out of oil and its price rising
- Potential impacts of climate change
- Competitive advantages

II. Synthetic liquid fuels

Synthetic fuel or synfuel is any liquid fuel obtained from coal, natural gas or biomass. It can sometimes refer to fuels derived from other solids such as oil shale, tar sand, waste plastics or from the fermentation of biomatter. The main advantages are that burns cleaner producing fewer carbon emissions, has excellent low temperature properties that improve high altitude operations and low temperature starting and better thermal stability, which makes possible the development of highly fuel efficient engines. However, lack of sulfur, which is positive contribution for the environment, causes two main problems for aircraft engines. The first is that it reduces the fuel's lubricity, which brings stress on an engine's moving parts. The second one is that less sulfur results in fewer aromatic hydrocarbons, which, in traditional fossil fuels, have the desirous effect of causing engine seals to swell preventing leakage. Challenges concerning the large-scale production of synthetic liquid fuel may make its long-term use very problematic. Although this type of fuel produces low carbon emissions, total amount of carbon emissions generated through the fuel's production and use are estimated to be twice that produced by the use of conventional petroleum fuel.

Another fact is that they produce equivalent levels of CO2 to petroleum kerosene.

III. Bio fuels

Biofuels are also considered as an alternative fuels for aviation. They are a synthetic fuel products that use biological matter as a feedstock, e.g. corn, oil crops, cellulosic plants such as fast-growing trees, prairie grass, agricultural waste and animal fat. However, unlike synthetic fuel from coal and natural gas, biofuel can theoretically be carbon-neutral, current production methods involve the use of some carbon emitting sources, which detracts from the claim of carbon neutrality. The challenges concerning the using of bio fuels in commercial aircrafts is its propensity to freeze at normal operating cruise temperatures and the stability, consistency and storage stability of the oil overtime. In its present state of technological development, the energy density of biofuel is too low to make it a suitable substitute for jet fuel. Bio fuel appears as a mid-term option, but may be affected by limited production capacity due to its requirements for considerable land resources, which may generate other environmental and social costs.

IV. Ethanol fuel

This fuel can be combined with gasoline in any concentration up to pure ethanol (E100). Ethanol is, by far, mostly used to power cars. It has very poor mass and volumetric heats of combustion and are not satisfactory for use as a commercial aircraft fuel. Ethanol is not a good option for long-haul aircraft, because it would require design modifications (much larger wings and engines reducing its fuel efficiency) but may be relevant to regional short-haul and general aviation.

V. Hydrogen

Hydrogen powered fuel cells are a potential alternative power source having many positive attributes. Through an electrochemical process that combines hydrogen and oxygen it produces water and heat as waste products. They are more efficient than combustion engines and hydrogen itself can be acquired from various sources. Although combustion of hydrogen emits no carbon dioxide emissions and is lightweight, its production, handling, infrastructure, and storage offer significant challenges. It is obvious that we can await dramatic changes in aircraft design due the demand of implementing new technologies. The use of hydrogen fuel will also require an entirely new and more complex ground transportation, storage, distribution, and vent capture system. The use of hydrogen in aviation is expected to start with fuel cell applications for the replacement of Auxilliary Power Units (APUs), ram air turbine (RAT) and distributed power units. These applications will generate large fuel savings on the ground, lower noise and lower NOx. Hydrogen may be a very long-term option for aircraft engines dependent on technological developments and investments (e.g. airports will have to be converted).

VI. Conclusion

The potential for alternative fuel use in aviation is not a new concept. Early jet engines were developed using hydrogen, but the very strict technical requirements for aircraft to use a fuel with high energy content per weight and volume led to the adoption of kerosene as the standard aviation fuel. The dramatic rise in fuel prices in recent years and months has caused intense concern within the air transport industry. It is clear that the air transport industry will be one of the first sectors within the transport industry to take the lead by using alternative fuels. As mentioned above, none of these so-called green alternative fuel options fittes in all aspects and they are not so green after all. This sustainable approach deserves to be further explored, as well as many other aspects concerning the use of alternative fuels not only for aviation application, but also for use in many other sectors. Developing alternative fuels will help to improve each country's energy independence, could help lessen global-warming effects, and will soften the economic uncertainty of crude oil peaking. Due to fact that jet fuel forms just about 6 percent of global oil consumption and requires high-performance characteristics, synthetic fuels would be much more suitable in this case. Technically, the biofuels with its lower performance should be used particularly for ground transportation. Although the use of hydrogen fuel in modern aero engines is feasible, for now is very costly and much technological development is needed.

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