Ain Shams University
Institute of Environmental Studies
And Research

THE EFFECT OF USING BIODIESEL AS AIRCRAFT FUEL ON AIR QUALITY IN SOME EGYPTIAN AIRPORTS

By
Abdelrahman Mahmoud Raafat Hassan Zalat
B.Sc. Faculty of Science (Chemistry dept.), Ain Shams University, 2005

A Thesis Submitted in Partial Fulfillment
of
The Requirement for the Master Degree
in
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APPROVAL SHEET

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This thesis Towards a Master Degree in Environmental Sciences
Has been Approved by:

Name Signature

1-Prof. Dr. El Sayed Mohamed El Sayed Mansour
Prof. of Organic and Polymers Chemistry
Faculty of Science
Alexandria University

2-Dr. Mohamed Abd El Moneem Farouk
Head of Environmental Mangement Sector
EEAA

3-Prof. Dr. Mahmoud Ibrahim Mahmoud Hewahy
Prof. of Public Health, Department of Environmental Basic Sciences
Institute of Environmental Studies and Research
Ain Shams University

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Under The Supervision of:

1- Prof. Mahmoud Ahmed hewehy
Prof. of Public Health
Environmental Basically Sciences Dept.
Institute of Environmental Studies and Research
2- Dr. Mohamed Mohamed Khalil El hakim
International Expert on Committee of Aviation
Environmental Protection
ICAO, UN

2016

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ABSTRACT

The continuing increase in demand for commercial aviation transport raises questions about the effects of Biodiesel as an alternative fuel for aircraft on the airports environment. The purpose of this study is to compare, assumption of using Soy biodiesel (B_{20}) as an Aircraft fuel on Sharm el-Sheikh International Airport's air quality vs. actual fuel used Diesel (Jet A1). The International Civil Aviation Organization (ICAO) defines standard power settings for jet engines at 7%, 30%, 85%, and 100% corresponding to the idle, approach, climb-out, and takeoff modes, respectively. These modes define the Landing and Takeoff (LTO) cycle developed as part of the jet engine certification process started in the 1970s. The results will only concentrate on the estimated emissions of from ground level to 9357ft (average mixing height layer). The estimated atmospheric emissions of aircraft operations at SSH for the year 2013 are presented in this paper. The landing and takeoff (LTO) emissions of hydrocarbons (HC), carbon monoxide (CO), nitrogen oxides (NO_X), and particulate maters (PM), were calculated using the flight data recorded by the Egyptian airports company. Emission factors from the International Civil Aviation Organization Engine Exhaust Emission Databank were used for different aircraft operation modes such as take-off, climb-out, approach, and taxi/idle engine conditions. Total LTO emissions from aircrafts at SSH were estimated as 442.047 t /year for HC, 37660.742 t /year for CO, 69340.331 t /year for NO_X, and 9.674 t /year for PM. The predicted total LTO emissions from aircrafts at SSH for the year 2050 were calculated as 4928.8241 t /year for HC, 419917.27 t /year for CO, 773144.69 t /year for NO_X, and 107.8651 t /year for PM. The aircrafts at SSH are the major sources of NOx emissions (99.95%), Boeing 777 (large aircraft) has the biggest portions in NO_x total emissions, in which contributing 6.836t /LTO for NO_X.Flight numbers are expected to reach 483822 by 2050. That represents

5.42 % average annual growth in Flights at SSH. The emissions concentrations are normally well below the air quality limit values given in Law No. (4/2004) of Egypt and its amendment No. (9/2009), by the World Health Organization, and other different Countries guideline values. The assumption of use biodiesel (Soy biodiesel B_{20}) for aircraft engines at SSH for year 2013 leads to the substantial reduction in PM, HC and CO emissions 0.987 t/year, 93.272 t/year, and 4142.682 t/year, respectively accompanying with the increase in NO_x emission 1386.806 t/ year. Moreover, the prediction of reduction in emissions for year 2050 are estimated as 11.00505 t/year for PM, 1039.9828 t/ year for HC, and 46190.9043 t/year for CO, accompanying with the increase in NO_x emission 15462.8869 t/year. There are very little effect on emissions reduction when using biodiesel (Soy biodiesel B_{20}) for APU & aircraft handling comparing with aircraft main engines were estimated emissions reduction for APU during 2013 as 0.8023378 t/ year for HC, and 1.0155631 t/ year for CO, accompanying with the increase in NO_x emission 0.2479944 t/year and for aircraft handling as 1.5077697 t/ year for HC, and 1.1828047 t/ year for CO, accompanying with the increase in NO_x emission 0.6560550 t/ year. The measurement of average concentration of the regulated air emissions (HC, NO_x, CO) at distance away 8 km from Runway were estimated for using Diesel (Jet A1) as 0.8281 μg/ m^3 for HC, and 4.617 μg/ m^3 for CO, and 343.7607 μg/ m^3 for NO_x, while for The assumption of use biodiesel (Soy biodiesel B_{20}) for aircraft engines as 0.6534 μg/ m^3 for HC, and 4.1091 μg/ m^3 for CO, and 350.6359 μg/m^3 for NO_x.

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