Atmos. Chem. Phys. Discuss., 13, C3814–C3816, 2013
www.atmos-chem-phys-discuss.net/13/C3814/2013/
© Author(s) 2013. This work is distributed under
the Creative Commons Attribute 3.0 License.

Atmospheric Chemistry and Physics Discussions

Interactive comment on "Reductions in aircraft particulate emissions due to the use of Fischer–Tropsch fuels" *by* A. J. Beyersdorf et al.

K. P. Geigle (Referee)

KlausPeter.Geigle@dlr.de

Received and published: 17 June 2013

General comments

The manuscript describes particulate measurements in different distances behind real aero-engines operated with alternative fuels and kerosene as reference. Optional two Fischer-Tropsch fuels and their 50:50 blends with conventional kerosene were tested and PM characteristics determined. To my knowledge, this research is the only work on detailed PM characterization behind engines studying the influence of alternative fuels and as such highly relevant for future aero-engine design and aircraft emissions.

The overall presentation of the results is clear and concise, the language adequate and use of graphics well serving to understand the text content. Although the results are

not surprising, the manuscript for the first time proves evidence for the expected behavior for particle numbers in full scale testing, combining a unique suite of conventional (=sampling) diagnostics. In addition, the influence of replacing kerosene by FT fuels on particle sizes is shown, and aging effects downstream the engine are analyzed.

Specific comments

- Table 1 lists two different instruments for number measurements – which of both threshold values (4 or 6 nm) was used for the plotted number densities? Were the identified trends qualitatively equal for both systems / how did they compare?

- In the second paragraph the authors mention the search for alternative fuels having similar physical properties; they might add that similarities of chemical/combustion properties are equally desired (heat of combustion, ignition delay, flame speed ...).

- Were the sampling lines heated? What about line losses? Was tip dilution applied or has the sample been diluted x m downstream in the line? I suggest adding one or two references on the sensitivities related to "technical sampling".

- Independent from the manuscript contents: is extrapolation of the ambience temperature dependence possible to in-flight conditions?

- On page 15114 the authors mention that "The EI_V values follow the same trend as EI_BC, however the trend in EI_N differs due to varying particle size with power (Fig. 4)." I suggest adding a short description of the trend difference.

- Page 15116: "Further downwind, these particles are likely to coagulate causing a drop in EI_N while EI_V remains constant." – where is this statement evident from the plots?

- Page 15117: "Conversely, the soot-mode particle number concentration increases as power increases." – where do I see this? I suggest referring to suitable figure.

- Page 15119: "Comparing each of the fuels, the efficiency follows a similar trend with

low efficiencies at low and high power (0–1.5 %) and maximum conversion at mid-power (1.5– 4%)." Is this trend significant relative to signal error bars/reproducibilities?

- In the conclusions the authors elaborate on the influence of ambience temperatures on aerosol formation by condensation. Couldn't the determined effect be a question of temperature history? Maybe the plume simply needs a moderately longer time (i.e. distance) to show the same condensation mode intensity at slightly warmer ambience temperature?

- Fig. 4: is there an argument why the JP-8 idle emissions increase at large diameters?

- Fig 5, density subplot: why is scatter so much larger for 65% load?

- Fig. 8: mostly, the vertical ordering of colors for a power setting is following temperature, but not always. What is the main reason for the scatter? What are the errors/reliability bars of the single dots?

- Fig 13: Is identified trend for conversion efficiencies significant over scatter behavior of single dots?

Technical

- I suggest replacing °C consistently by K.

- Abstract lists PM mass reductions when using alternative fuels, absolute; I suggest adding relative values.

- On page 15114 the authors write "... result of formation of soot from primary spherules"; these primaries ARE already soot. I recommend an expression like "... result of formation of soot aggregates from ..."

- Page 15114: "Density calculations are only made ..." – authors should clarify which volume this density is referring to.

Interactive comment on Atmos. Chem. Phys. Discuss., 13, 15105, 2013.