IMPACT OF BLENDING OXYGENATED FUELS WITH JET FUEL ON SOOT FORMATION IN WICK-FED LAMINAR DIFFUSION FLAMES

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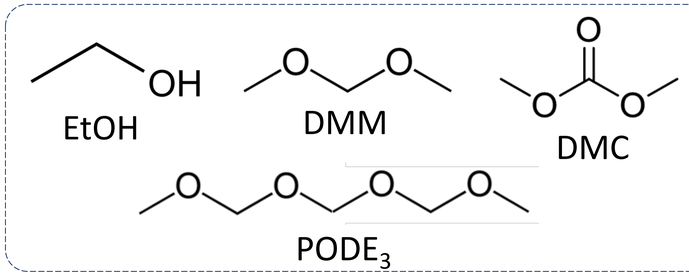
INTRODUCTION

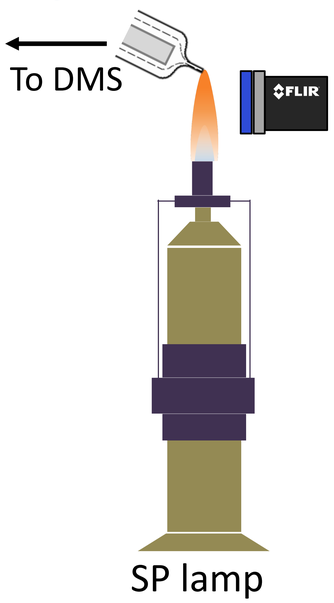
The aviation sector is anticipated to grow over the next two decades. Conventional aviation fuel remained the sole prominent means to powering air transport. Sustainably-sourced oxygenated fuels are promising to be blended with conventional aviation fuel to reduce the carbon footprint of the aviation industry.

OBJECTIVE

To have a deeper understanding of the pollutant emission from the combustion of oxygenated fuels, specifically ethanol (EtOH), dimethoxymethane (DMM), dimethyl carbonate (DMC) and poly(oxymethylene) dimethyl ethers ($PODE_3$) when blended with jet fuels in ASTM D1322 smoke point (SP) lamp.

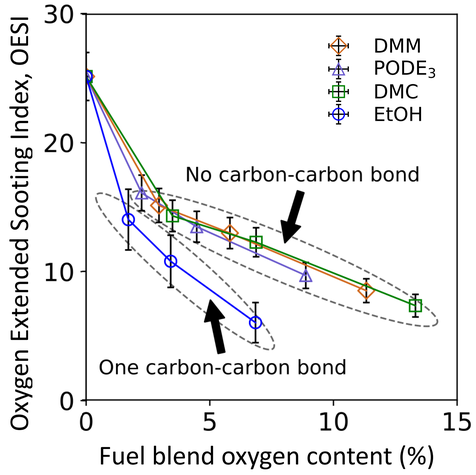
METHODOLOGY





- Up to 20 vol.% of oxygenated fuels were blended with jet fuel.
- Colour-ratio pyrometry and differential mobility spectrometry (DMS) were used to determine the soot volume fraction (f_v) and flame tip average particle size, respectively.

RESULTS AND DISCUSSION

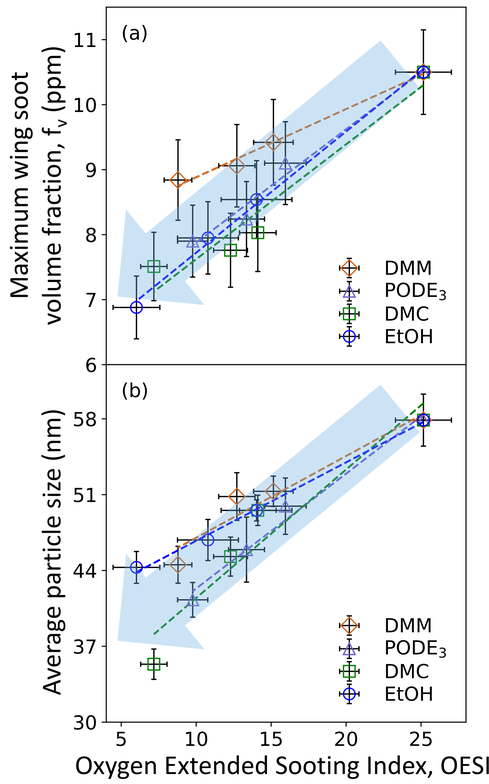


- For oxygenated fuels without C-C bonds, the OESI is tightly correlated with the fuel blend oxygen content percentage.
- The deviation observed for EtOH (contains a C-C bond) suggests that other than oxygen content effect, oxygenated fuel structure is also important in understanding the OESI reduction with increasing oxygenated fuel blending.

The OESI[§] with fuel blend composition $C_nH_mO_p$:

$$OESI = a_{\mathrm{OESI}}\left(\frac{n+\frac{m}{4}-\frac{p}{2}}{SP}\right)+b_{\mathrm{OESI}}$$

[§] E. J. Barrientos et al., Combustion and Flame, 160(8), 2013, 1484-1498.



- The results suggest that OESI can be useful to correlate f_v and average particle size in flames.
- The differences observed may be attributed to the differences in the oxygenated fuel structure and the fuel blend oxygen content.

CONCLUSIONS

We have shown for the first time that OESI is well-correlated with the average particle size and the f_v using SP lamp, with minimal distinctions between the oxygenated fuels studied. It justifies the usage of OESI from SP lamp to evaluate the emission quality of oxygenated fuel-blended jet fuels.

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