Alternatives Fuels – A commodity or an enabler?

ICAO AF Workshop, 8th Feb 2017
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Change in focus

• Last 60 years of development and optimization
  • Given fuel – build engine
  • Long service life of aircraft

• Looking forward
  • Given engine(s) – build fuel
    ∴ Same fuel from a different resource
  • Fuel has harder ride as engine $\eta$ increases

• Are Alternative Fuels a commodity …or an enabler?
Current situation

• Safety is paramount: The specification works

• A multi dimensional space for Jet A-1

• The majority of fuels sit in even narrower corner of this space

• Impact of AF fuels…
Impact of AF

- Currently constrained by requirement for drop-in
- As %age of AF increases, average fuel will shift
- Impact in Long term - Due diligence required (structure in place to do this)
- Including Fit for Purpose understanding
Impact on Air Quality

- A 50:50 blend of Jet A-1 and Alternative fuel: 60% reduction in air pollution (nvPM mass based)

- Small scale studies help assess impact on Local Air Quality and climate change

- Low aromatics challenge for seals – system needs to be assessed multidimensionally

Lobo et al. (2015)
Impact on thermal stability

- Fuel operates as heat sink in engine – stability is critical
- Purer fuel greatly improves performance
- Higher specific heat
- Very low Sulphur levels require lubricity additive to pump in current engines
Future fuels

- Assessment needed of non CO₂ impact of synthetic fuels within and beyond the limits of the specification

- Future platforms design may exploit change in composition (additional sfc improvements)
Upcoming Questions

• Inside Specification box – how far can we go?
  • Effect of increasing isomerisation
    • Boiling point range, LBO, altitude relight…
  • Effect of lower levels of aromatics or which ones?
    • Fuel gauging, range / payload, emissions, seal performance, thermal stability…
  • New EU H2020 programme - JETSCREEN 2017 - 2020

• Outside Specification box
  • Risk vs benefit needs assessment
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Back up
Fuel Composition Change?

- Fuel properties
- Physical mechanisms
  - Atomisation, Chemical kinetics,…
- Combustor performance
  - LBO, Altitude relight, gaseous emissions, PM emissions,…
- Interaction with fuel system
  - Hot end durability, Seal compatibility, thermal stability,…

Aromatic content
Paraffinic groups
Carbon number distribution…
Optimising fuel blends

- Forcing ourselves to meet the specification limits the potential for Alternative Fuels
- Short / medium term: drop-in fuels to boost deployment of SAF
- But Longer term: consider changes to fuel specification & engine design?

Elmalik (2014)