Microbiological Contamination in Aircraft Wing Tanks

Why is Microbiological Contamination a Problem for airlines?

A little Historical Background

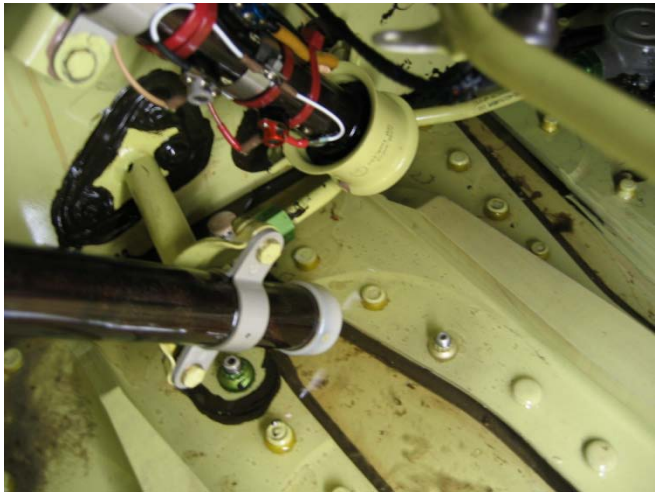
- World wide problem. Commercial & Military Aircraft, especially those based in the tropics
- About 90 different microbes Fungus, yeast, bacteria
- Most common Hormoconis resinae "Jet fuel fungus“
- Recent studies indicate that the types have changed over time. As a result the current biocides are no longer as effective
- They consume fuel and produce corrosive organic acids. (SRB's reduce any sulphur present into corrosive sulphates)

Why is Microbiological Contamination a Problem for airlines?

Aircraft Contamination

This can:

- Fuel Filter blockage
- Pump failures
- Wing tank corrosion
- Block drain holes
- Foul fuel probes
- Destroy coatings and sealants
- Block engine filters



Microbiological Contamination

Supplier contamination

- Water control in tanks crucial
- Filters can reduce contamination but can also be a source of contamination

Microbiological Contamination

Actual problems

- Fuel Tank Temperature change on Intercontinental flights…
  Long distance flights from northern hemisphere to southern hemisphere always have summer – winter flights… additional water accumulation.
- Problems with water removal…
  - blockage of water drain ports due to maybe frozen valves
  - blocked valves by microbiological slime
- Water scavenging issues
- Spores come in via the air as well

Microbiological Contamination

Actual problems

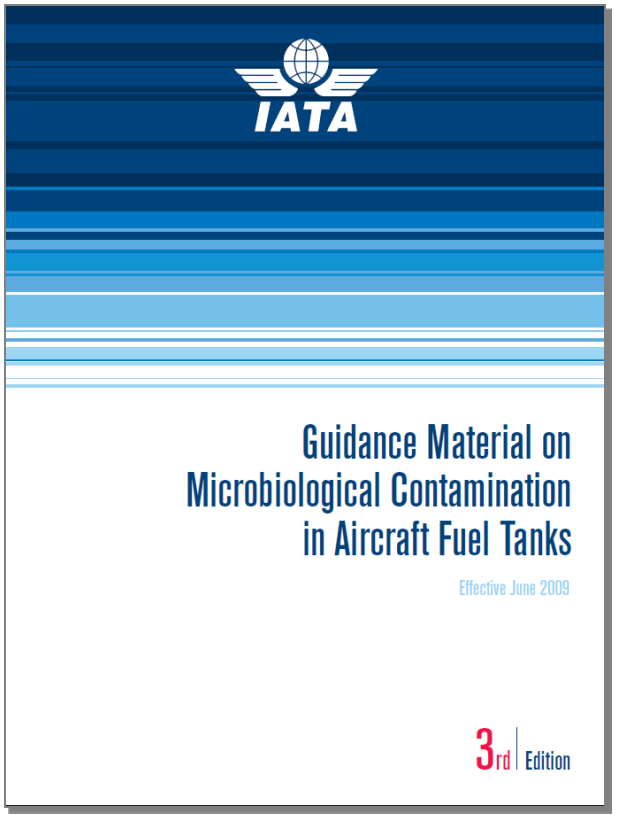
Microbiological Contamination

Actual problems

GM on Microbiological Contamination

Content of the GM

- Introduction
- Fuel Supplier Practies
- Prevention Strategies for A/C Fuel Tanks
- Detection of Microbiological Contamination
- Fuel Tank Decontamination
- Training of Maintenance / Engineering People
- Manufacturer and Distributor Information
- Evaluation Criteria for Test Kits
- Order to Accept Kerosene
- Recommended Test Methods
- Test Kits Comparison Table



Biocides

IATA approved Biocides for usage within aircraft fuel tanks only.

- Biobor JF – manufactured by Hammonds
  Is a mixture of dioxaborinane 95%, petroleum naphtha 4.5%
  Density 1.05 g/ml at 20°C/68°F
  Flash point 40 +/- 1°C/104+/-2°F
- Kathon FP 1.5 – manufactured by Rohm & Haas Company
  Is a mixture of chloro- and methyl- isothiazolones 1.5%, dipropylene glycol 88.0-90.0%, magnesium nitrate 1.7-1.8%, magnesium chloride 0.9-1.0%, water 5.0-6.0%
  Density 1.044 g/cm3 at 25°C/77°F
  Flash point 138°C/280°F.

Note: Although Biobor JF and Kathon FP 1.5 have not been approved in some geographical areas. Local regulatory agencies must be consulted with respect to approval status.

Testing Aircraft Fuel Tanks

Objectives for Microbiological Tests

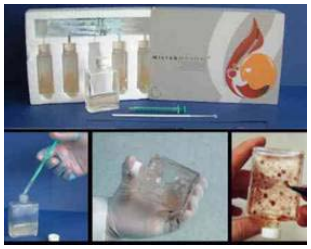
- determine whether there is a potential for microbiologically related operational problems.
- determine whether existing operational problems may have been caused by microbiological contamination.
- determine whether antimicrobiological control measures have been successful.

Frequency

- For each fuel tank on each aircraft, testing for microbiological contamination at least once a year is strongly recommended.

Testing Aircraft Fuel Tanks

IATA recommended Test Kits



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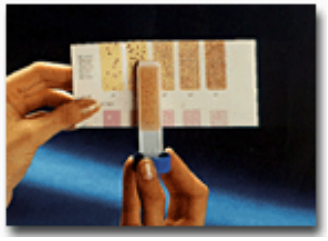

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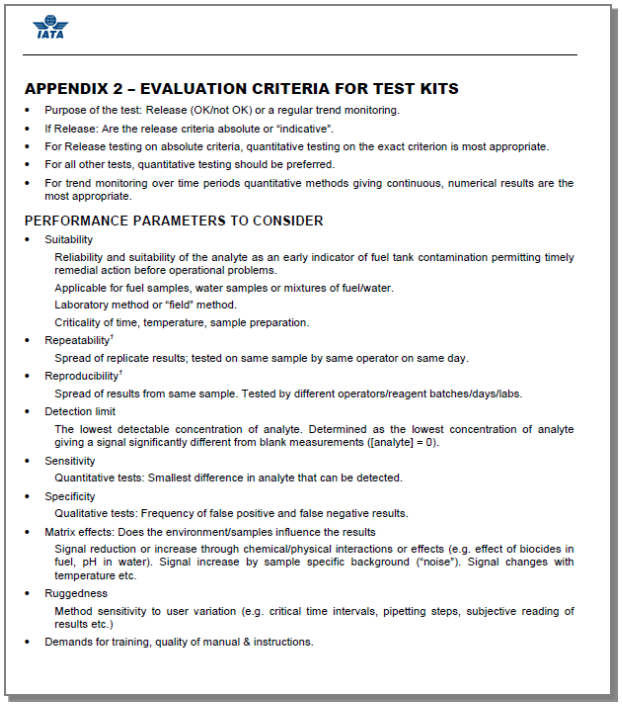
Approval Process of New Test Kits

IATA recommended Test Kits

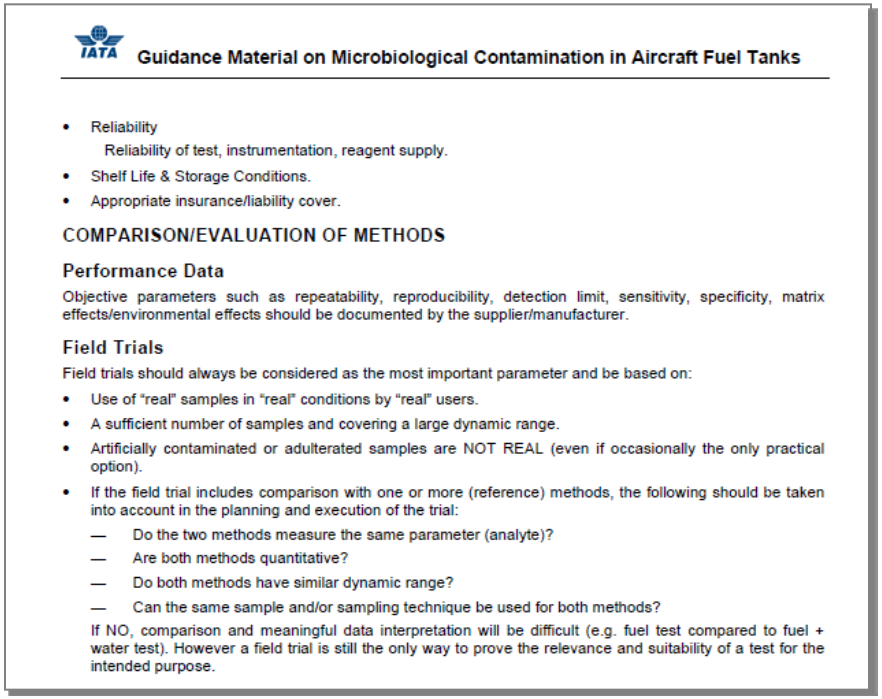


APPENDIX 2 – EVALUATION CRITERIA FOR TEST KITS

- Purpose of the test: Release (OK/not OK) or a regular trend monitoring.
- If Release: Are the release criteria absolute or "indicative".
- For Release testing on absolute criteria, quantitative testing on the exact criterion is most appropriate.
- For all other tests, quantitative testing should be preferred.
- For trend monitoring over time periods quantitative methods giving continuous, numerical results are the most appropriate.

PERFORMANCE PARAMETERS TO CONSIDER

- Suitability
  Reliability and suitability of the analyte as an early indicator of fuel tank contamination permitting timely remedial action before operational problems.
  Applicable for fuel samples, water samples or mixtures of fuel/water.
  Laboratory method or "field" method.
  Criticality of time, temperature, sample preparation.
- Repeatability†
  Spread of replicate results; tested on same sample by same operator on same day.
- Reproducibility†
  Spread of results from same sample. Tested by different operators/reagent batches/days/labs.
- Detection limit
  The lowest detectable concentration of analyte. Determined as the lowest concentration of analyte giving a signal significantly different from blank measurements ([analyte] = 0).
- Sensitivity
  Quantitative tests: Smallest difference in analyte that can be detected.
- Specificity
  Qualitative tests: Frequency of false positive and false negative results.
- Matrix effects: Does the environment/samples influence the results
  Signal reduction or increase through chemical/physical interactions or effects (e.g. effect of biocides in fuel, pH in water). Signal increase by sample specific background ("noise"). Signal changes with temperature etc.
- Ruggedness
  Method sensitivity to user variation (e.g. critical time intervals, pipetting steps, subjective reading of results etc.)
- Demands for training, quality of manual & instructions.



Guidance Material on Microbiological Contamination in Aircraft Fuel Tanks

- Reliability
  Reliability of test, instrumentation, reagent supply.
- Shelf Life & Storage Conditions.
- Appropriate insurance/liability cover.

COMPARISON/EVALUATION OF METHODS

Performance Data

Objective parameters such as repeatability, reproducibility, detection limit, sensitivity, specificity, matrix effects/environmental effects should be documented by the supplier/manufacturer.

Field Trials

Field trials should always be considered as the most important parameter and be based on:

- Use of "real" samples in "real" conditions by "real" users.
- A sufficient number of samples and covering a large dynamic range.
- Artificially contaminated or adulterated samples are NOT REAL (even if occasionally the only practical option).
- If the field trial includes comparison with one or more (reference) methods, the following should be taken into account in the planning and execution of the trial:
  - Do the two methods measure the same parameter (analyte)?
  - Are both methods quantitative?
  - Do both methods have similar dynamic range?
  - Can the same sample and/or sampling technique be used for both methods?

  If NO, comparison and meaningful data interpretation will be difficult (e.g. fuel test compared to fuel + water test). However a field trial is still the only way to prove the relevance and suitability of a test for the intended purpose.

Approval Process of New Test Kits

IATA recommended Test Kits

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Testing Aircraft Fuel Tanks

New Developments

- Since biocides are only allowed at aircraft level, there is an interest for innovative ways to kill the microbes before they enter our systems
- There is always an interest in new detection methods but they should be:
  - Fast
  - User friendly
  - Real field tests
  - Cost competitive
  - Cover a sufficient range of jet fuel microbes
  - Approved by running a field trial

Comments !! / Questions??

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to represent, lead and serve the airline industry