Remedial Strategies For Microbial Contamination In Biodiesels

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solving microbiological problems in industry

Overview

- Remediation Strategies
- Prevention Strategies
  - New EI Technical Bulletin

Remediation Strategy

- Strategy will depend on type of problem

The Problem – Microbial Biomass

- Fouls fuel tanks & infrastructure

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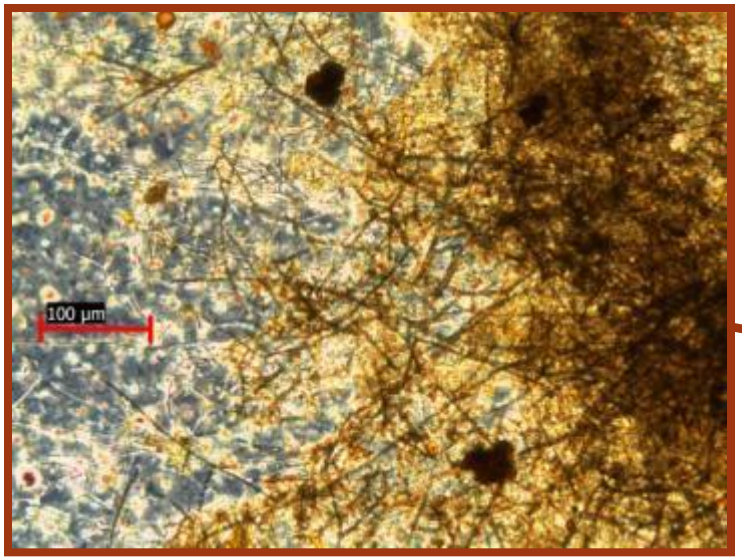
The Problem – Microbial Biomass

- Causes increased particulates in fuel
  - Poor fuel quality
  - Fuel unfit for purpose



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The Problem – Microbial Biomass

- Causes filter plugging in
  - Vehicles
  - Retail site pumps

Fungal mat on truck filter

Retail Site Pump Nozzle Filter with Fungal Growth

Photo courtesy Eurotank Envionmental

The Problem – Microbial Surfactants

- Cause haziness and water entrainment

Hazy Automotive Diesel (left)

Emulsification at fuel water interface - Microscopic water droplets become suspended in fuel

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The Problem – Microbially Generated Sulphide

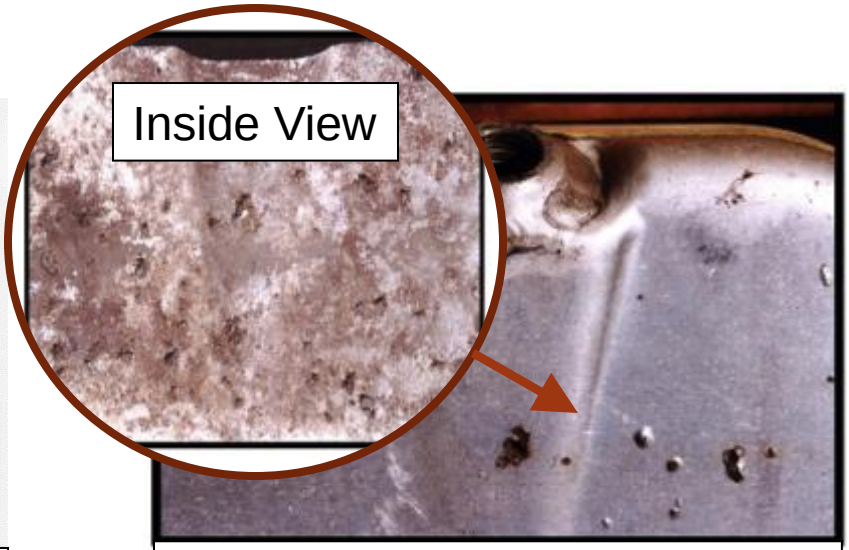
- Fuel can fail specification and become corrosive

Black/grey discolouration of water and fuel in tank bottoms indicates sulphide generation by Sulphate Reducing Bacteria (SRB)

The Problem – Microbially Influenced Corrosion

- Rapid pitting corrosion due to microbial activity (acids, sulphide and oxygen gradients)

Pitting corrosion of tank bottom plate due to SRB



Microbial Corrosion of truck saddle tank sump

Picture courtesy FQS Inc.

Treatment – Practical Strategies

- There is a big gap between what is theoretically possible and what is practical and effective in fuel systems

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•Heat	YES – Most microbes are killed rapidly above 65°C. e.g. Vacuum Distillation, Thermal Cracking. Not practical downstream for automotive fuels.

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•Magnetism?	Lack of convincing scientific evidence.

Remediation

- When heavy active microbial growth is present in a fuel tank or system, we recommend a biocidal treatment.
  - Fuel biocides
  - Aqueous biocides

Remediation – FUEL biocides

- Fuel solubility enables the biocide to be distributed to all parts of the system.
  - Good mixing is essential
  - The biocide migrates to any water phase and biofilm to kill microbes
- Fuel biocides are effective against microbes in;
  - Fuel
  - Tank and associated pipelines and systems.
- Fuel biocides remain effective for as long as treated fuel remains in the system
  - providing the fuel is not diluted excessively with untreated fuel.
- Fuel biocides can be burnt with fuel by end-user
  - there are no biocide disposal issues.

Remediation – FUEL biocides

- MUST Consider
  - Environmental impact
  - Safety
  - Regulation (e.g. EU Biocidal Products Directive)
  - Combustion characteristics
  - Compatibility with fuel and additives
  - Compatibility with fuel system and engines
  - Engine and fuel system OEM approvals
  - Speed of action
  - Spectrum of anti-microbial efficacy
    - Fuel
    - Tank and pipelines(including surface biofilms)
  - Cost

Remediation – FUEL biocides

- If tanks or systems are VERY heavily contaminated;
  - Fuel biocides may fail to penetrate thick slime (biofilm) on surfaces.
  - Biocide treatment may initially cause increased particulates in fuel.
- For VERY heavy contamination, tank cleaning is recommended BEFORE fuel biocide treatment.

Remediation – WATER SOLUBLE biocides

- As an alternative to treatment with a fuel biocide, a water soluble biocide can be used in conjunction with tank cleaning
  - Apply as soak, fog or spray
  - A wide range of possible candidates
    - Hypochlorite, hydrogen peroxide, biocidal system cleaners
  - Treatment may need considerable downtime.
  - Specialist application equipment may be necessary
  - Compatibility with system and fuel is critical!
  - We usually only recommend water soluble biocides where treatment with a fuel biocide is not desirable or acceptable.

Is there a case for continuous biocide use in biodiesel?

- If good housekeeping measures fail to control growth there maybe a case for continuous biocide treatment by;
  - Addition of biocide to FAME or
  - Addition of biocide at time of blending with FAME
- Due regard should be given to;
  - Acceptability of biocide to fuel retailers and users
  - Acceptability of biocide in water drained from the treated tank and tanks downstream (Note; some biocides partition at high concentrations to water)
  - Risk that biocide will be ineffective if it is diluted by fuel blending downstream
  - Risk of developing tolerant microbes if the biocide concentration drops below an effective level
- Preventative biocide dosing is not a replacement for good housekeeping.

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TECHNICAL BULLETIN
Microbial Growth in Biodiesels and other fuels containing Fatty Acid Methyl Esters (FAME)

Available Q2 2011

"Providing industry with cost effective value added scientific and technical knowledge on key current and future issues"

EI Technical Bulletin

- Based on Industry experience and Energy Institute Research Project
- Provides Information on
  - Which fuels are affected?
  - What characteristics of FAME make it susceptible to microbial growth?
  - What additional measures can be taken to prevent occurrence of microbial growth?

- Supplements other EI Documents
  - EI *Guidelines for the Investigation of the Microbial Content of Petroleum Fuels and for the Implementation of Avoidance and Remedial Strategies*. 2nd Edition 2008
  - *Implications of biofuels on microbial spoilage and corrosion within the fuel distribution chain and end use* (May 2008)

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- It is far better and more cost effective to **prevent** contamination
- Remediation of operational problems can be difficult, costly and involve system downtime

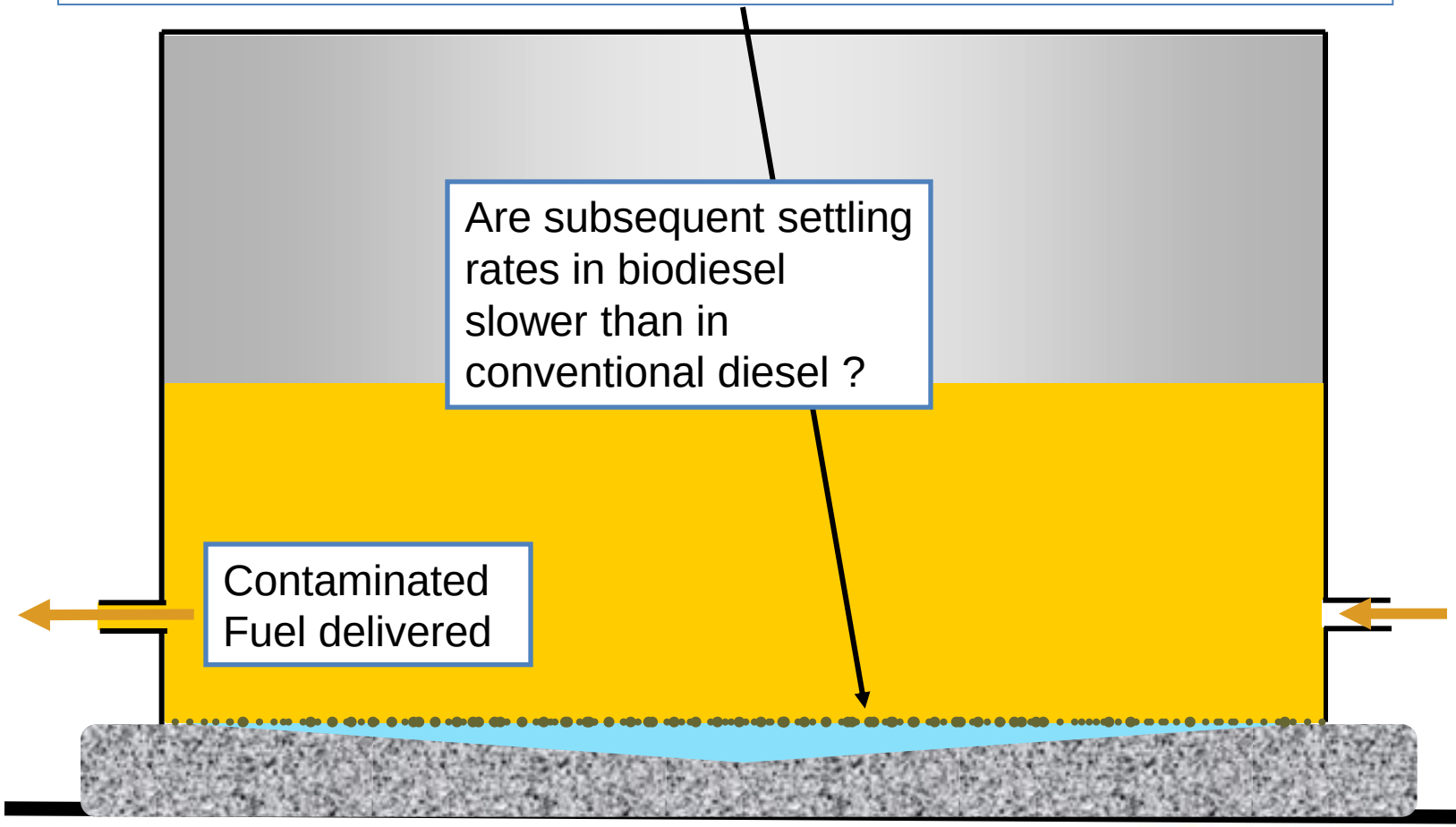
Prevention 1 – Product Settling

- Settle Fuel After Fuel Receipts
  - Microbial contamination and water on the tank bottom will be disturbed into bulk fuel phase by turbulence during fuel receipts
  - With time this contamination usually settles back to the tank bottom
  - Settling helps avoid;
    - supply of product potentially unfit for purpose
    - transfer of contamination and inoculation of facilities downstream.

Prevention 1 – Product Settling

Microbial biomass develops in tank bottom

Fuel receipts disturb this biomass

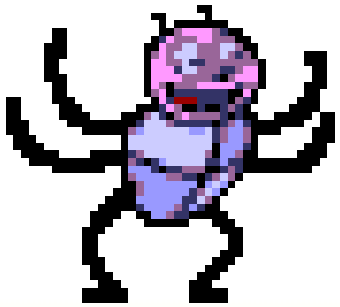


Prevention 2 - Minimize ingress and accumulation of water

- Drain tanks regularly (e.g. weekly, and after receipts).
- Do not wait for a certain level of water to be present before instigating draining.
- Sufficient water for microbial growth may be present even if it is not detected by “dipping”.
- Be prepared to drain tanks aggressively, including interface and product.
- Product can be recovered in separate tank.
  - Drain this tank regularly
  - Return product to main storage subject to good microbiological test result
- Avoid receiving wet product, wherever possible.
  - If wet diesel is received, take special precautions (e.g. additional draining, microbiological testing)

Prevention 3 - Microbiological Monitoring

- Without monitoring it is impossible to determine whether there is a risk
- Routine Monitoring can be used to;
  - Instigate early preventative action (more cost effective)
  - Indicate requirement for remediation
  - Validate effectiveness of remedial and preventative strategies
  - Emphasis should be on checking facilities are free of contamination NOT establishing a fuel microbiological “specification”



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SUMMARY

- If properly implemented, prevention and remedial procedures should;
  - Keep microbial contamination to low, tolerable and controllable levels.
  - Prevent significant contamination being spread downstream and to retail sites / end users.
- The is an onus on proactive prevention at all stages of distribution, delivery and end-use