**CEN/TC 19 2011 Conference**

# How to secure biofuel quality in the logistic chain

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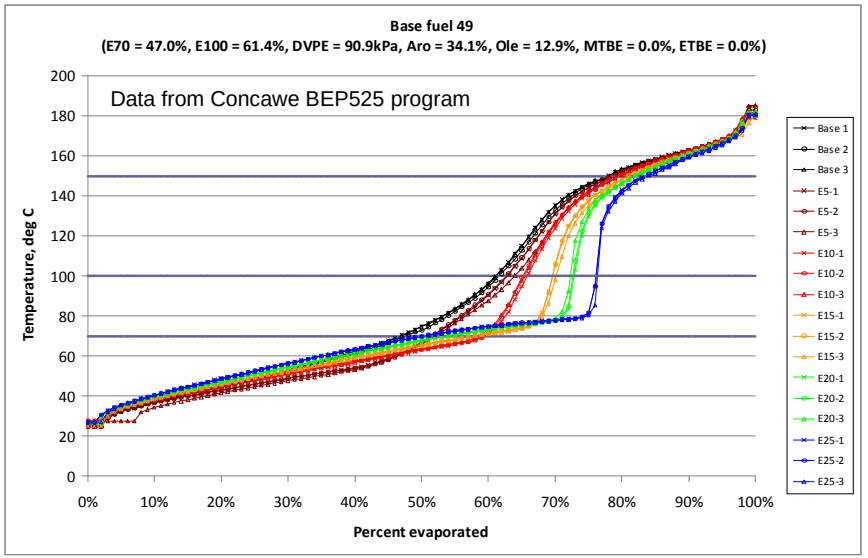
# Service and Handling Considerations

- → Ethanol
  - EN228 allows up to 5% volume – revision for 10% underway
  - Sensitive to water leading to phase separation
  - Impact on volatility, octane
  - Requires special blendstock (BOB)
- → ETBE
  - EN228 allows up to 15% volume → increasing to 22%
  - Can blend at refinery
- → FAME
  - EN590 allows up to 7% volume - must meet EN14214
  - Can blend at refinery and terminal locations
    - Good lubricity
    - Oxidation Stability & Cold Flow are challenging

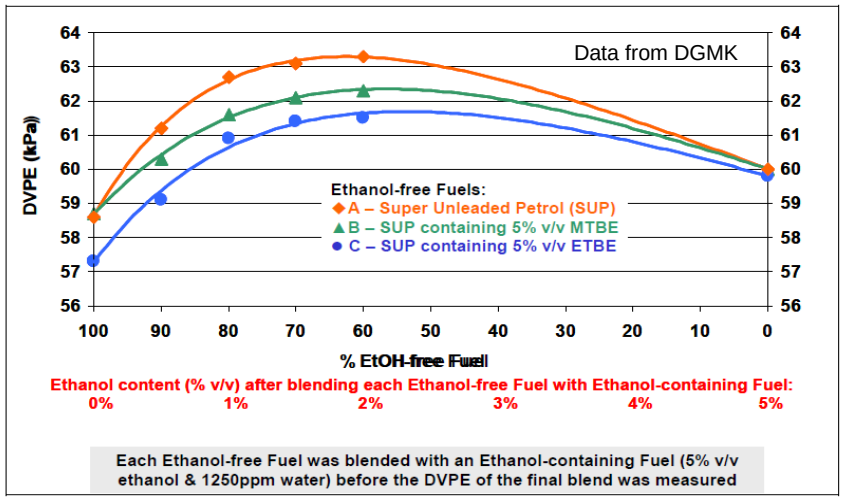
# Ethanol

# Ethanol Blending

- Blending properties of ethanol:
  - Good octane (110+ RON)
  - Increases vapour pressure and key distillation characteristics
  - DVPE → Dry Vapour Pressure Equivalent → 4 – 8 kPa
  - E70 → volume of fuel distilled at 70℃
  - E100 → volume of fuel distilled at 100℃




- Blendstock for Oxygenate Blending (BOB)
  - Refinery produced ethanol-free grade for distribution to terminals
  - Refiners ensure BOB + 5% ethanol meets all EN228 specifications



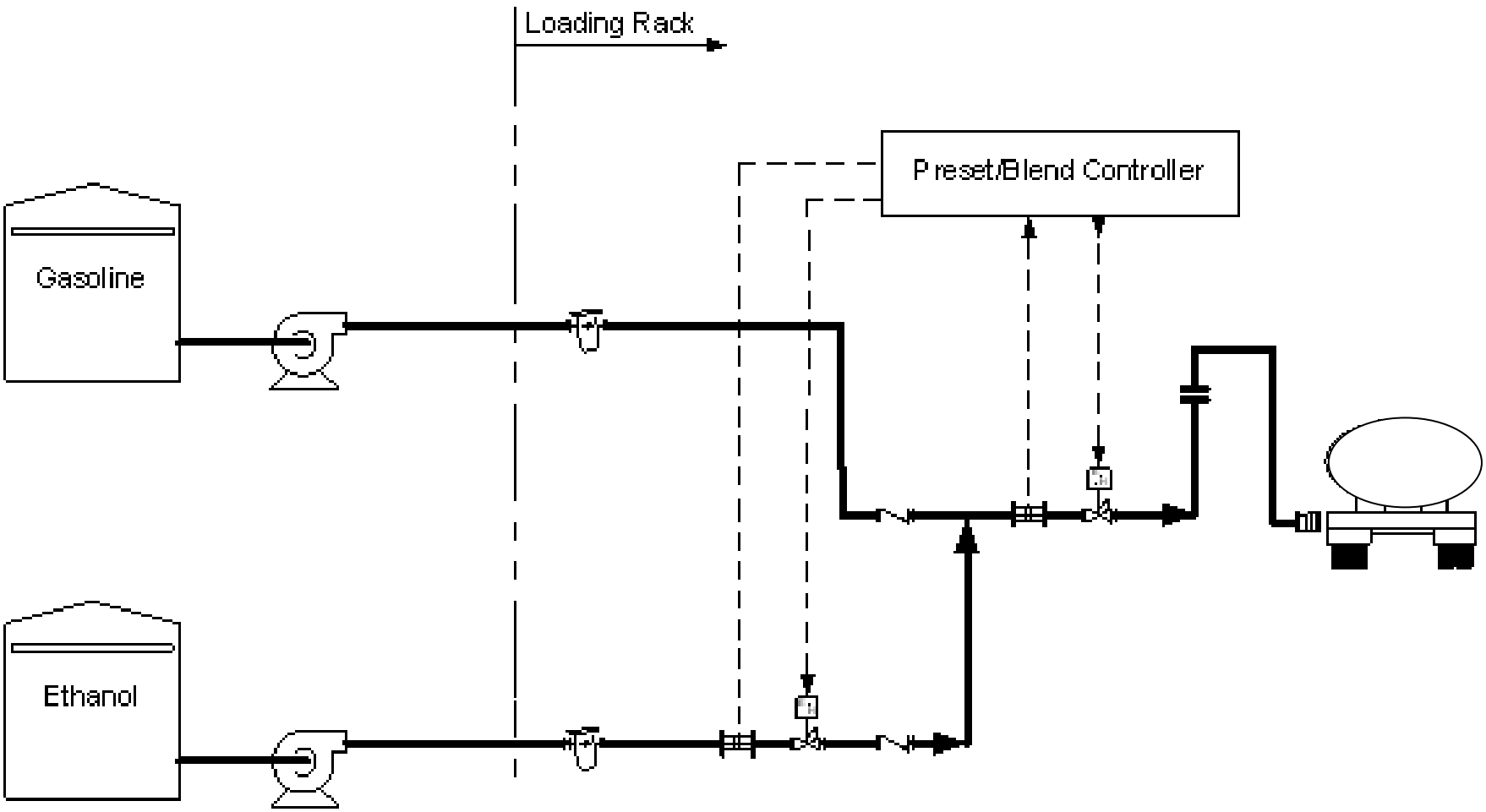
# Ethanol water sensitivity

- Due to the presence of the hydroxyl (-OH) group, ethanol exhibits strong hydrogen bonding interactions:
  - Very similar to those found in liquid water
  - This effect means that ethanol is hydrophilic in nature and has a strong affinity for water
- As a consequence, ethanol has a tendency to absorb water that may be present in distribution, storage, and vehicle fuel systems even when the ethanol is only present at low concentrations in gasoline
- This tendency means that extra precautions are required especially when ethanol is first introduced into the supply and distribution system

# Terminal Blending

- Terminal blending of ethanol considered best practice
  - Eliminates water sensitivity issues in refinery & distribution system
  - Multi-product pipeline shipment usually not practical because of the risk of water pickup and risk of deactivation of jet fuel coalescers
  - In-line blending of BOB + ethanol at terminal rack
    - Ensures product quality risks minimised
  - Provides tight control of blend ratios
  - Manual blend correction if truck loading interrupted
  - Critical to ensure ethanol tank kept dry
  - Recommend the addition of corrosion inhibitor to the ethanol
  - Ensure materials compatible with ethanol
- Concawe report (03/08) - 'Guidelines for blending and handling motor gasoline containing up to 10% v/v ethanol'
- Refinery blending and pipeline/ship transport possible with appropriate controls to keep water out

# Terminal Blending Schematic



# Practical Considerations for Ethanol Use

- → Supply
  - BOB cannot be used as fuel alone, so EtOH supply must be assured
  - Contingency plan should consider alternate supply locations, refinery turnarounds etc.
  - Terminal supply flexibility → must segregate ethanol & conventional grades in service stations
- → Service station care is important
  - Cleaning/draining of tanks on changeover
  - Check all seals tight & adequate water run-off from covers
  - Ongoing water monitoring → auto detectors may not work
  - Mitigate with routine tank dips and/or water detection filters
  - Essential to avoid crossovers with conventional gasoline
- → Petroleum products - Guide for good housekeeping
  - CEN/TR15367-2:2007 Part 2: Automotive petrol fuels

# Biodiesel

# Biodiesel Blending

- EN590 requires FAME meeting EN14214 specification:
  - Specification originally developed around Rapeseed Methyl ester
  - Expanding sources of vegetable and animal oils
    - Other Methyl Esters such as Soy, Palm, Sunflower, Tallow, used cooking oils etc
    - Renewable Energy → waste (tallow and used cooking oil) count double
- Product Quality → 3 main areas of concern:
  1. Cold flow performance of the finished fuel
     - Maintain biodiesel blend homogeneity in storage
     - Filterability – operability both above and below finished blend cloud point
     - Vehicle operability
  2. Stability
     - Long term storage
     - On vehicle degradation
     - High temperature engine deposits
  3. Microbiological Growth (MBG)
     - Housekeeping practices critical to avoiding MBG

# Biodiesel Blending (2)

- Refinery blending:
  - Ideally blending should be carried out at the refinery into warm product run-down to ensure thorough mixing and dissolution of cold flow additives
  - Important that cold flow additives are compatible with base fuel and FAME component to avoid antagonistic reactions
  - Product can be thoroughly tested and certified
    - Advantage taken of good properties – lubricity, cetane, low sulphur etc
    - Disadvantages mitigated, poor cold flow, filterability etc
- Terminal blending:
  - Requires special precautions:
    - Base diesel (DBOB) may need cold flow quality margin to ensure finished blend meets EN590 climatic requirements
    - Good mixing energy when blending
    - Ability to inject cold flow additives

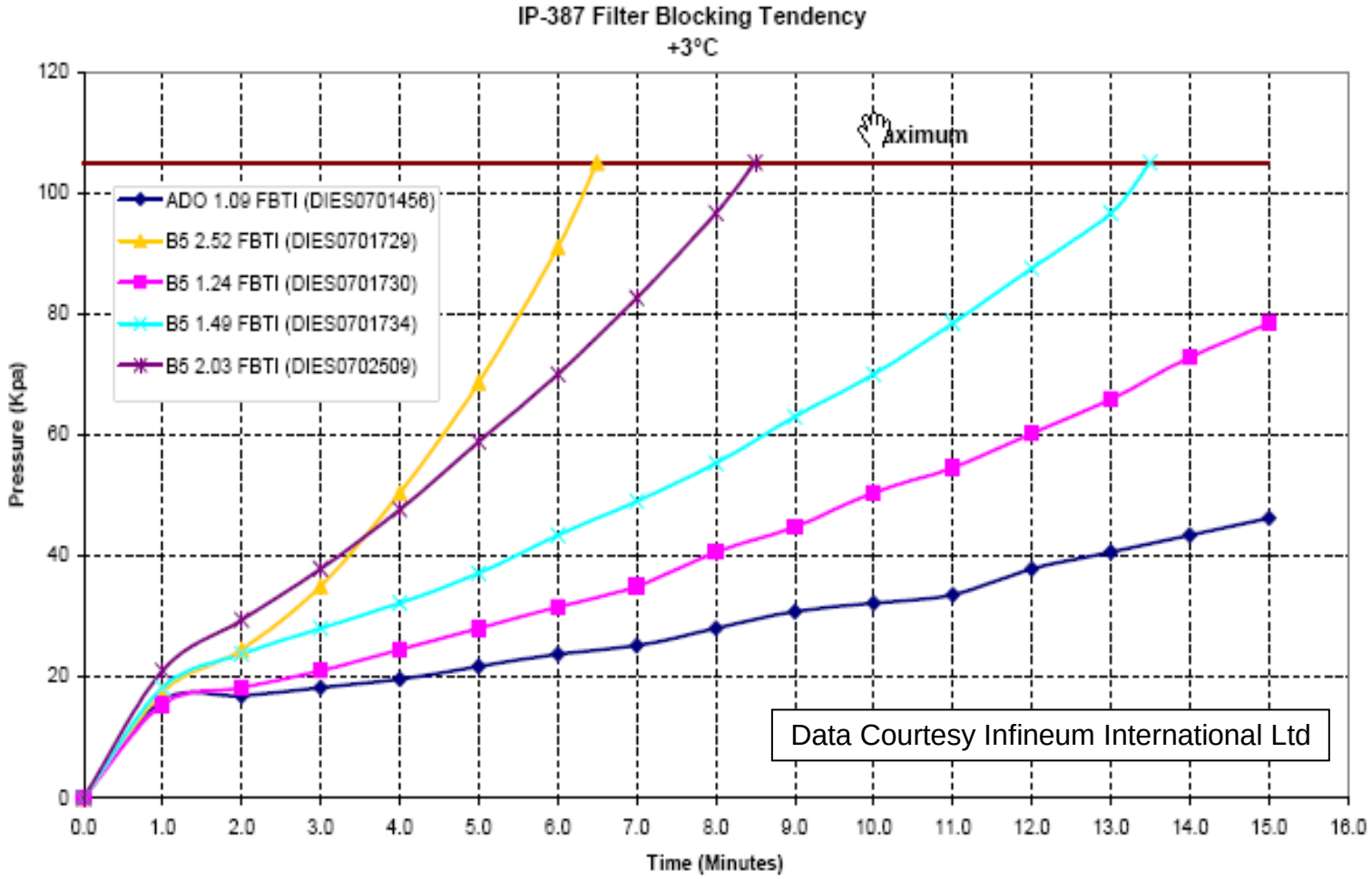
# Biodiesel Blending (3)

- Splash blending:
  - To ships, barges etc not recommended due to difficulties in guaranteeing homogeneity across all tanks
    - Temperature conditions and the presence of water can cause haze problems
    - Poor cold flow additive mixing conditions
    - Limited opportunity for thorough testing of finished blend
- Concawe report 9/09 Guidelines for handling and blending FAME
- Petroleum products - Guide for good housekeeping
  - Part 1: Automotive diesel fuels CEN/TR 15367-1:2007

# Biodiesel blend homogeneity

- Important that biodiesel blends remain homogeneous in manufacture, distribution and storage:
  - Must take account of seasonal ambient temperature variations
  - Co-mingling of different qualities
  - End use application
- Experience in the USA, Sweden & France suggests that contaminants are critical to blend homogeneity:
  - Filter plugging due to biodiesel component precipitation above finished fuel cloud point
    - Saturated Monoglycerides and Sterol glucosides
  - Revised prEN14214 improved cold flow requirements for EN590 blending – Cloud Point, CFPP and Total Monoglycerides

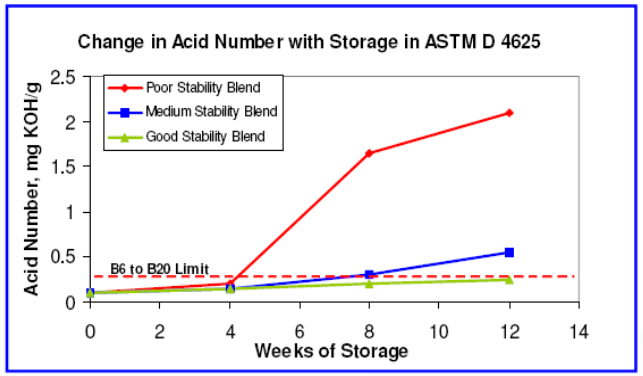
# Biodiesel Blend Filterability at + 3℃ Temperature




→ B5 blends exhibit worse filterability performance at lower temperatures

# Biodiesel Stability

- Evidence that FAME stability has a strong influence on the long term storage stability of diesel fuel:
  - Important for long term storage
    - Vehicle storage → dealer forecourt etc
    - Emergency use – power generation etc



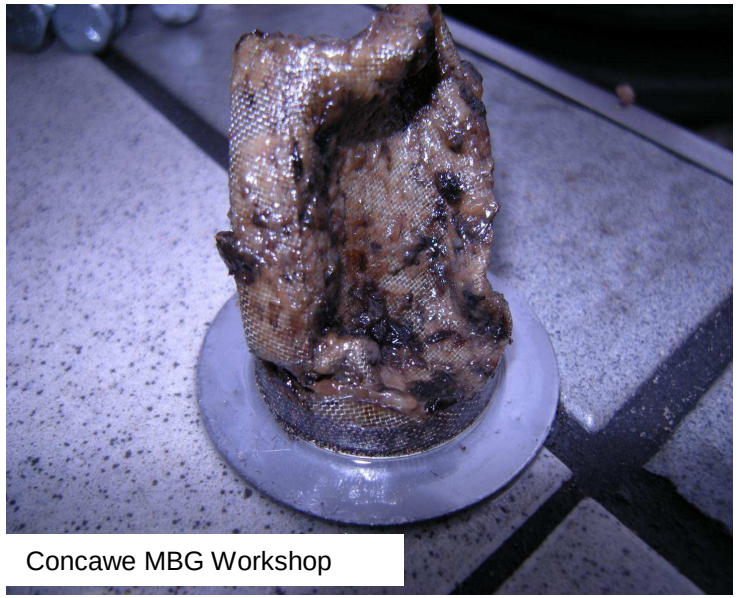

McCormick & Westbrook NREL/TP-540-41619

- Conventional diesel fuel stable >1 year:
  - ASTM D4625 43℃ storage for 12 weeks – 1 week approx = to 1 month
- FAME oxidation process different from conventional fossil diesel
  - Need to accommodate both failure mechanisms in testing and certification hence EN12205 and EN15751 test methods include in EN590
  - Increased EN15751 performance in prEN14214 → 6hrs →8hrs
  - Stability additives strongly recommended

# Microbiological Contamination

- Growth of bacteria, yeasts and moulds has been identified in hydrocarbon distillate fuels and fuel components in refinery blend and product storage tanks, terminal storage tanks and distribution facilities….This is not a new phenomenon as it was first recorded in the international literature in 1895*

Concawe MBG Workshop



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* The Energy Institute – Guidelines for the investigation of the microbial content of petroleum fuels and for the implementation of avoidance and remedial strategies – January 2005

# Microbiological Growth

- The occurrence of Microbial Growth has increased in diesel fuels:
  - Increase coincides with the introduction of FAME blending into diesel
  - Diesel containing FAME is more susceptible to microbial growth
  - FAME levels in ADO will continue to rise due to FQD/RED
- Service station pump filters blocking with microbial growth
  - No customer complaints – pump filters are protecting vehicles in most cases
  - Occurring more frequently in some areas than others
- Terminal and refinery tanks often testing higher in microbial growth than previous experience
  - Improved housekeeping practices required – frequent storage tank water draining
  - Regular testing through the manufacturing and distribution chain to monitor microbial growth levels

# Summary

- → Terminal blending best practice for ethanol blending
- → Refinery blending best practice for FAME blending
- → Ethanol key issues:
  - Volatility
  - Phase separation
- → FAME key issues:
  - Cold flow
  - Stability
  - Microbiological growth
- → Water management – housekeeping critical to ensure product quality:
  - Ethanol → Phase separation
  - FAME → Microbiological growth

→Thank you for your attention