



Moving Forward

Leading the way for sustainable solutions

Biofuels *Experience in Shipping*



Experience with Biofuels in Shipping



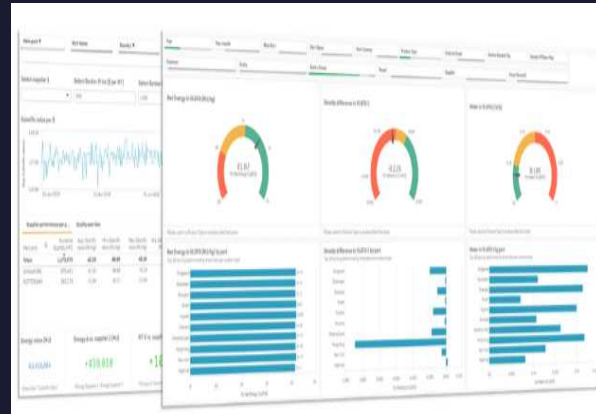
Agenda

Setting the scene

Preparation

Bio-Components

Properties to watch out for



Shipping sector needs to decarbonize and reduce greenhouse gas (GHG) emissions

Biofuels are an early choice on the road to decarbonization

Regulation (IMO 2030/2050 GHG emission reduction targets, CII Regulation, FuelEU, EU ETS, EU MRV, DCS etc.)



Biofuels are mainly “drop-in” fuels

B30 - 30% Bio (70% HSFO/VLSFO/MGO)

B24 - 24% Bio (76% HSFO/VLSFO/MGO)

B50 - 50% Bio (50% HSFO/VLSFO/MGO)

B100 - 100% Bio

Approval from Flagstate / Classification Society (Marpol Annex VI, Reg. 18)



Understanding challenges and drawbacks

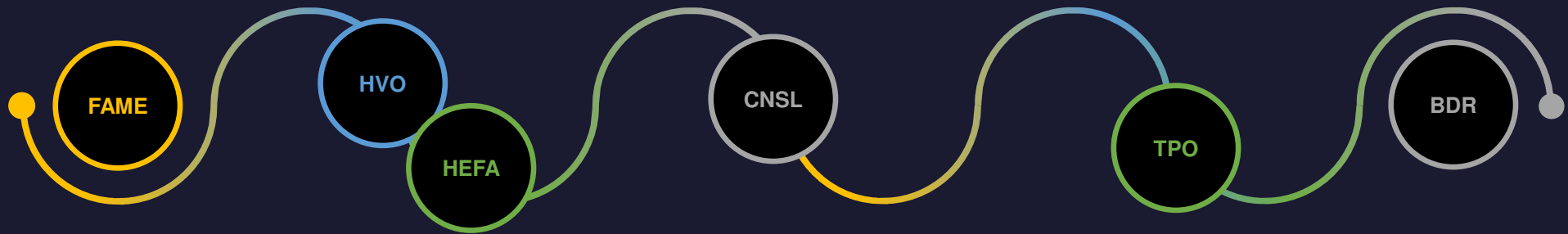
Big differences between “Biofuels”

Get approval from engine manufacturer

Check with equipment manufacturers on material compatibility

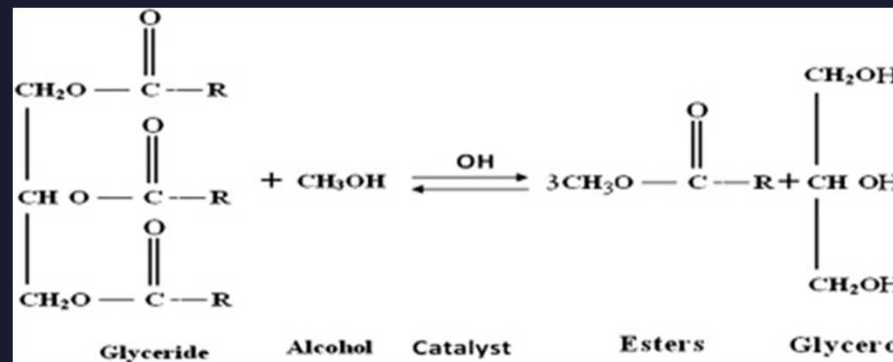
Consider cleaning tanks & system before first usage ... respect the greater solvency & cleaning effect

Range of different types
of biofuels is growing rapidly ...



FAME is a mixture of Fatty Acid Methyl Esters

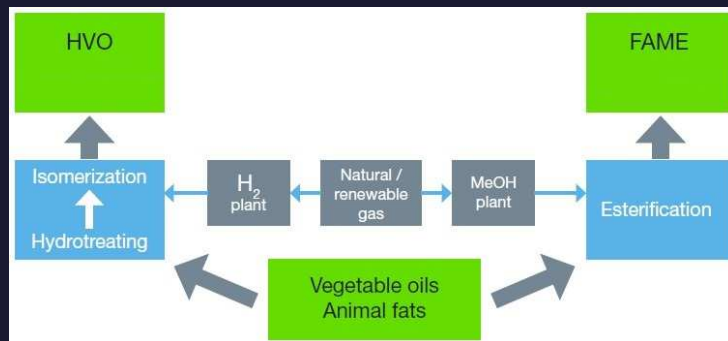
Fuel properties
are determined
by
the FAME
composition



FAME
Carbon chain-length
is
typically
C14-C20

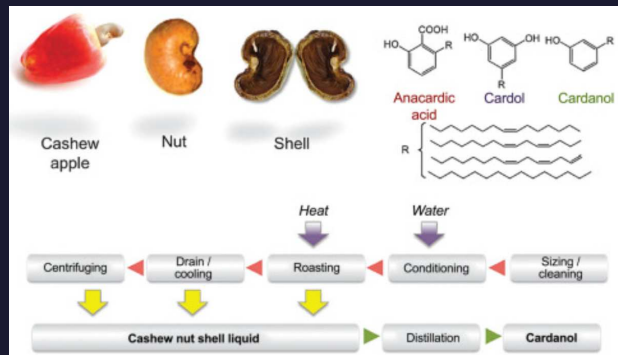
The composition of FAME compounds can be determined

- Hydrogenated Vegetable Oils (HVO)
- Hydroprocessed Esters and Fatty Acids (HEFA)



- ✓ Produced from a fatty acid feedstock
e.g. vegetable oils, waste animal fats or cooking oils
- ✓ Hydrogen/Nickel is used as the catalyst
- ✓ Hydrogenation removes oxygen
- ✓ Containing no aromatics or Sulphur
- ✓ No Glycerols as a side product

➤ Cashew Nut Shell Liquid (CNSL)



- ✓ By-product of the Cashew Nut industry
- ✓ Readily available; lower demand than FAME
- ✓ Relatively low-cost and renewable substance
- ✓ Mainly constituents are phenolic compounds
- ✓ Contains reactive monomers
- ✓ Composition & properties depend upon production process

➤ Cashew Nut Shell Liquid (CNSL)

- ✓ Do not use 100% CNSL as a marine fuel
- ✓ Traditional marine fuels blended with CNSL may reduce the risk
- ✓ CNSL-blended fuels with MGO, VLSFO or HSFO have shown mixed reactions to vessel operations
 - Some CNSL-blends have been stored and burnt without issue
 - Some CNSL-blends have given rise to operational problems such as:
 - Fuel sludging
 - Fuel injector failure
 - Corrosion of engine parts
 - Filter clogging
 - Fuel system deposits
 - Corrosion of turbocharger nozzle rings
 - Damage to Selective Catalytic Reactor (SCR) units

➤ Tyre Pyrolysis Oil (TPO)

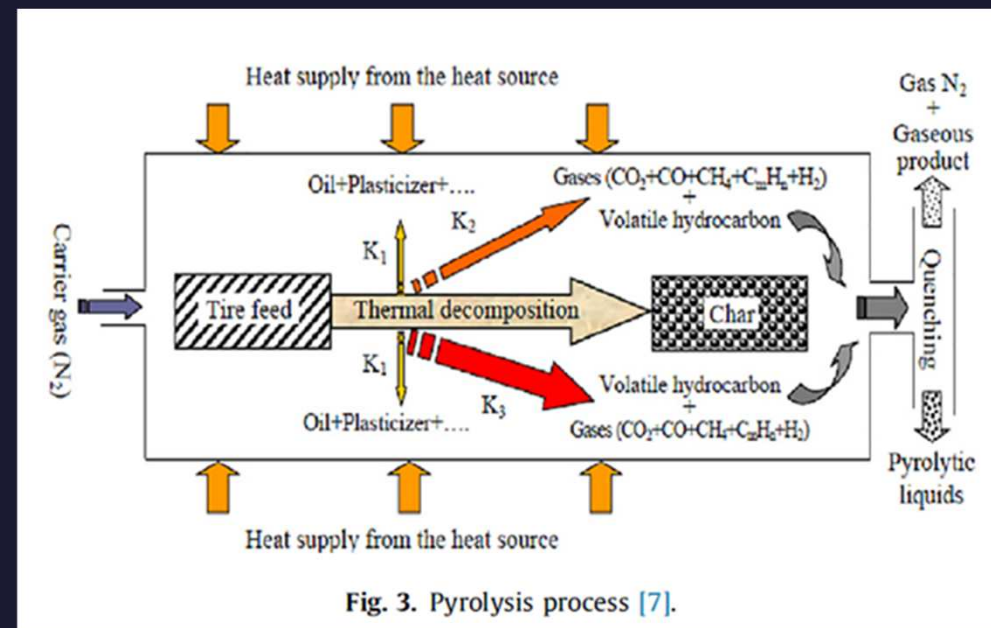
- ✓ Do not use 100% TPO as a marine fuel

Compared to Distillate Fuels...

- Higher Viscosity
- Lower Calorific Value
- Higher Sulphur
- Lower Flash Point
- Reduced Stability
- Lower Emissions

- ✓ Traditional marine fuels blended with TPO now offered to the shipping sector

5 % - 20% TPO blends expected



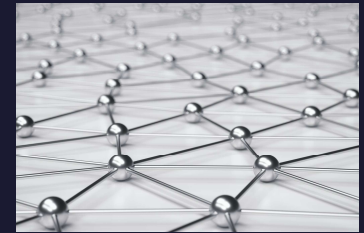
➤ Biodiesel-Residue (BDR)

- ✓ Residues of Biodiesel-production
- ✓ Degumming process

➤ Measurement of the following characteristics is key...

- ✓ RENEWABLE CARBON CONTENT
- ✓ STABILITY
- ✓ ENERGY CONTENT
- ✓ MICROBIOLOGICAL CONTAMINATION
- ✓ TOTAL ACID NUMBER / CORROSIVITY

"Manage Your Fuel"



"Monitor Your Fuel Quality"

➤ Renewable Content (FAME)

- ✓ FAME content must be made to determine the 'renewable element'
- ✓ Verify the reduction of CO₂ emissions when this fuel is combusted
- ✓ The BDN specifies a nominal Bio-content, but ...

➤ Stability

✓ Biofuel is significantly less stable than conventional marine fuels

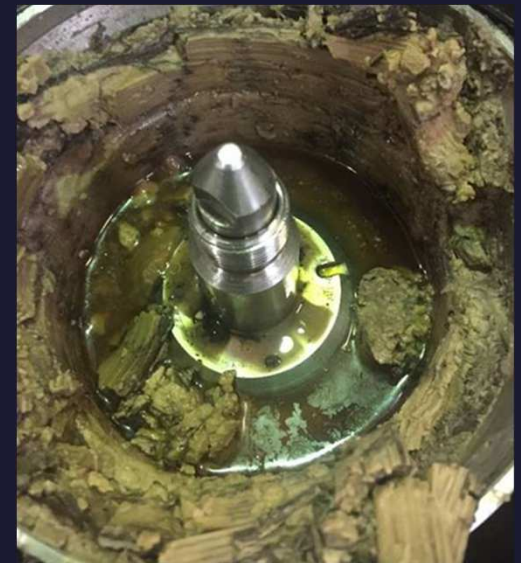
- Oxidation
 - Increased Acidity
 - Increased Viscosity
 - Eventually produce solid deposits
 - Block filters and pipes
- Instability
 - Unsaturated content
 - Storage time
 - Temperature



Biofuel oxidising over 3 week period (left to right)

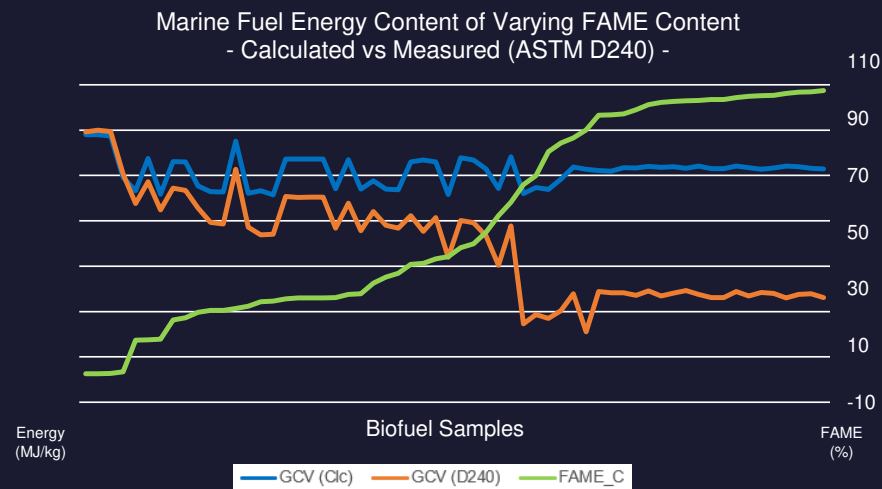
➤ Stability

- Oxidation Stability (EN 15751)
 - ✓ Rancimat method as accelerated-aging test
 - ✓ The European standard (EN 14112) - Lower limit of 8 hrs as the minimum induction period
 - ✓ VPS Ox Stab spec limit: Report via traffic light system
 - ✓ Green >8hr
 - ✓ Amber 5-8hr
 - ✓ Red <5hr



➤ Energy Content

- ✓ >10% FAME requires energy content to be measured by Lab Calorimeter (ASTM D240)
- ✓ Calculation method is not accurate



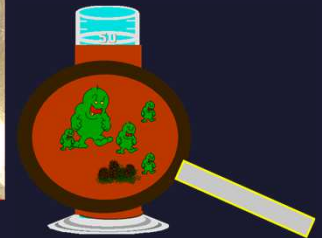
Lab Calorimeter

➤ Microbiological Contamination

- Microbiological activity in the form of Bacteria, Yeast and Fungi (BYF)

Combination of micro-organisms with water can result in ...

- ✓ Filter plugging
- ✓ Clogged pipes and heat exchangers
- ✓ Malfunction of water separating equipment
- ✓ Injection fouling
- ✓ Corrosion of different parts of vessels



! Microbiological contamination does not disappear with the fuel !

➤ Total Acid Number / Corrosivity

- Total Acid Number (TAN) of biofuels is a direct estimation of free fatty acid content
 - ✓ Method ASTM D664
 - ✓ TAN sharply increases upon oxidation
- Biofuels can be corrosive
 - ✓ Pitting corrosion common when in contact with aluminum, copper, copper alloys and carbon steel
 - ✓ Stainless Steel is the preferred metal
 - ✓ Copper Strip Corrosion 3 hr at 50, 100, 150 deg C (ASTM D130)
 - ✓ Steel Corrosion @ 20, 60, 120 deg C (LP 2902)

No ISO8217 grade available



Extended testing scope recommended



Singapore WA 2 : 2022 ... complementary to VPS direction with the understanding & using of Biofuel by ships
<https://www.singaporestandardseshop.sg/>

EXPERIENCE ► INNOVATION ► SUSTAINABILITY



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