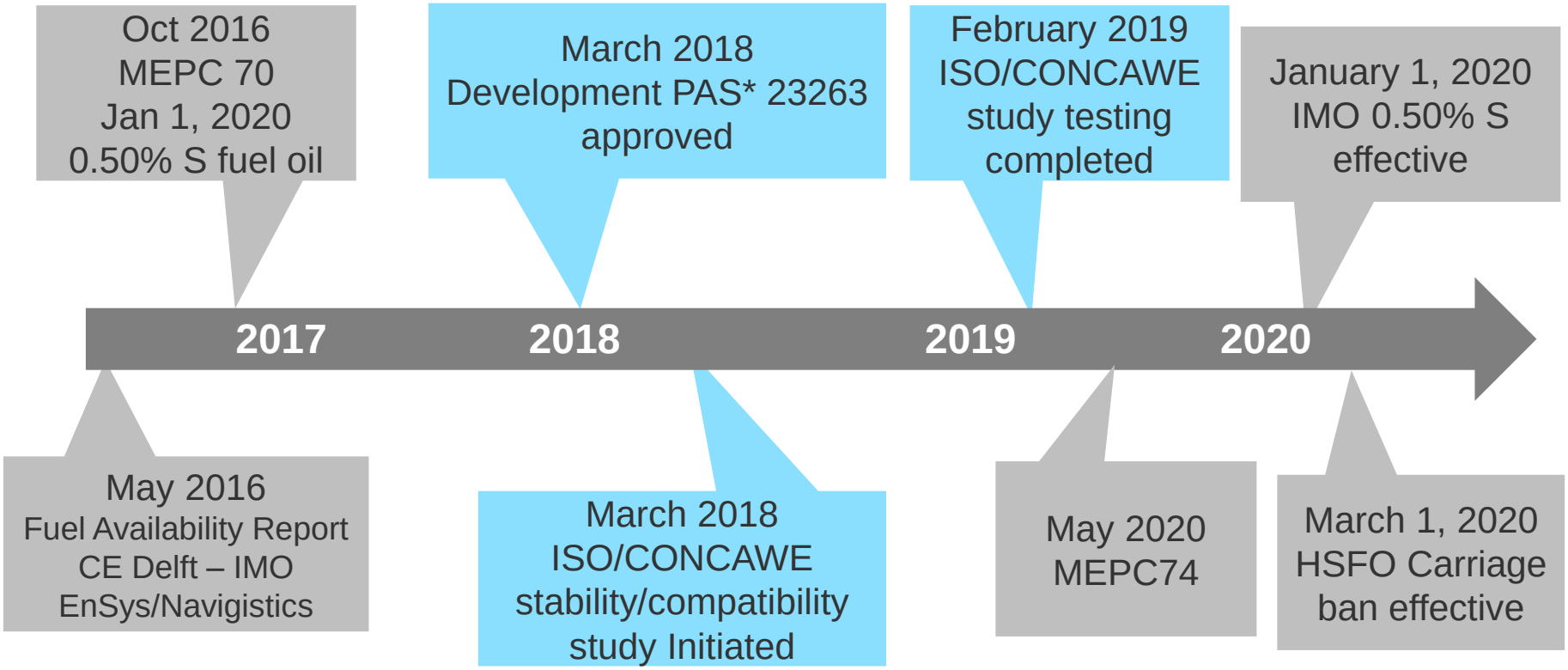
IMO 2020
ISO marine fuel compatibility study

Monique Vermeire
Convenor ISO/TC 28/SC 4/WG 6
Classification and Specifications of Marine Fuels

Fuels Technologist, Chevron

0.50% S Fuel oil timeline



MEPC70 : IMO requested ISO "*to consider the framework of ISO 8217 with a view to ensuring consistency between the relevant ISO standards on marine fuel oils and the implementation of regulation 14.1.3 of Marpol Annex VI*" and to report back to MEPC 74

*PAS – Publicly Available Specification

Marine fuel oil specifications

- ISO 8217 is regularly being revised based on users' experience of fuels available on the market & keeps pace with the requirements of a rapidly shifting marine industry
  - Is sufficiently detailed, technically balanced and realistic
  - Considers ship machinery developments, regulatory requirements, fuel availability, health and safety of ship and crew, testing methods

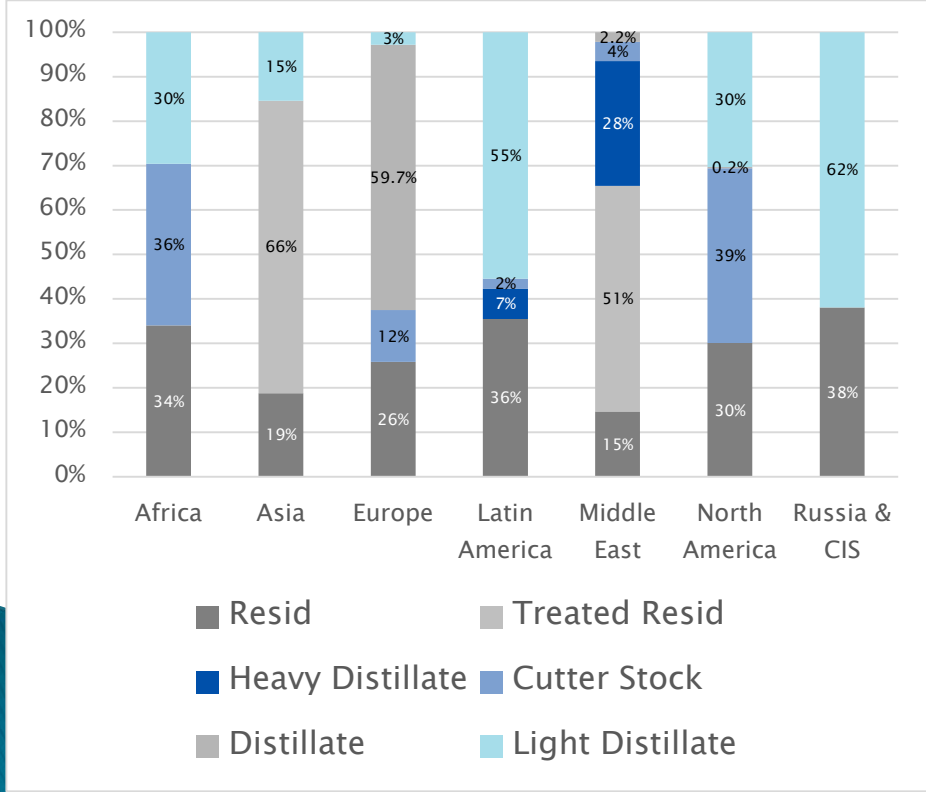
- ISO 8217 applies to all fuel oils, **including 0,10 and 0,50 % S fuels**

- Development of PAS 23263 initiated : Publicly available specification
  - Interim solution to respond to an urgent market need: will address specific considerations that may apply to 0,50 % S max. marine fuels
    - Potential fuel quality & safety issues that do exist already today and are being managed
  - Full revision of ISO 8217 after 2020

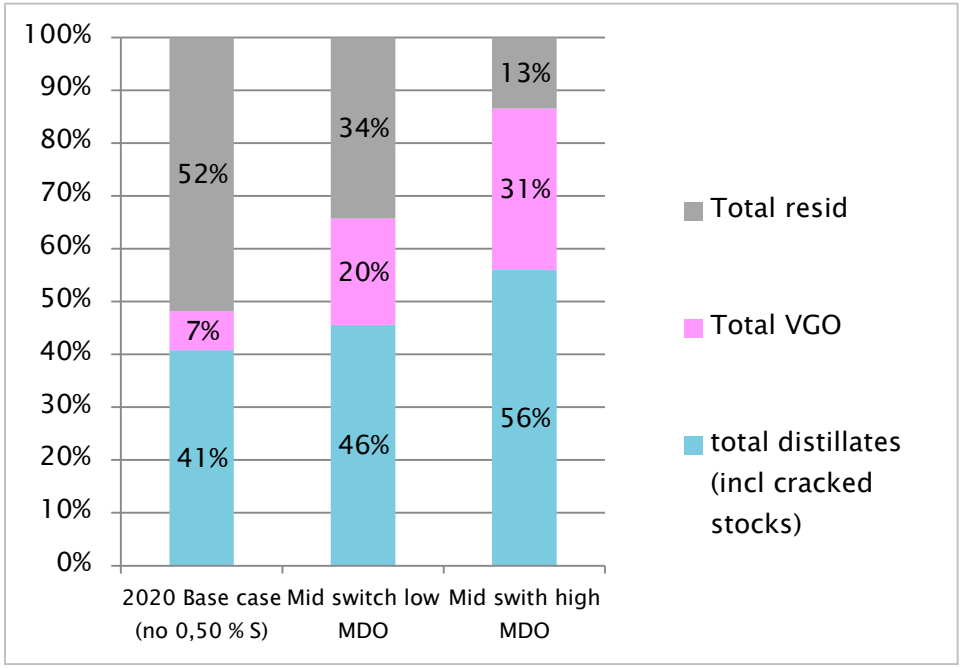
0,50 % S max. fuel oils

- Compliant fuels will be mix of distillate and residual type products, geographically different and different in nature than current high S fuel oils

CE Delft blend component types (%)

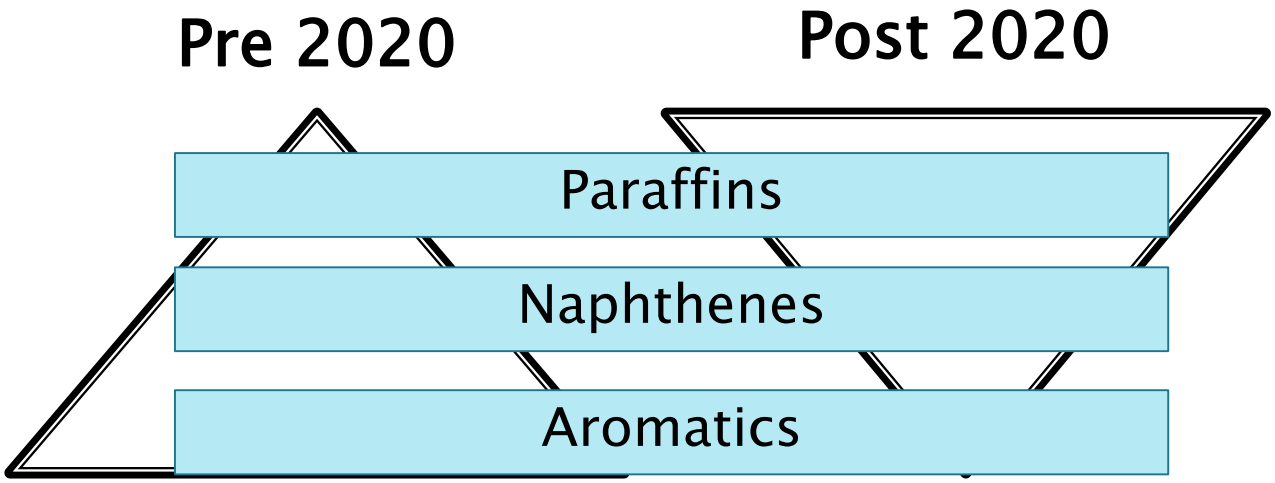


Ensys-Navigistics total marine fuel pool (%)



0,50 % S max. fuel oils

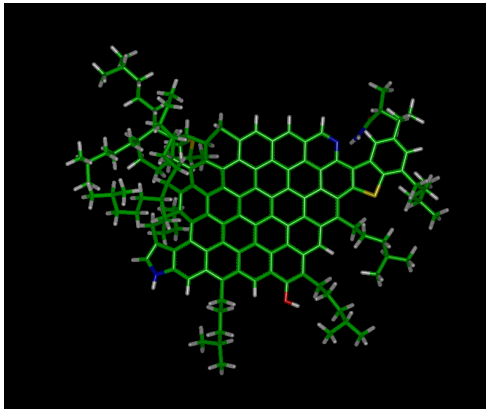
- Important properties for 0,50% S fuel oils, already included in ISO 8217
  - Cold flow properties
  - Viscosity
  - Stability
- Compatibility between fuel oils



Source : Ref: KBC/Mel Larson

0,50 % S max. fuel oils

- Fuels shall be stable and meet total sediment potential requirement of 0,10 % max.
  - TSA (total sediment accelerated) versus TSP (total sediment potential)
- Stability: resistance of the fuel to precipitate asphaltenic sludge
  - Asphaltenes: high molecular weight aromatic molecules kept in colloidal suspension
  - Aromatics in the fuel prevent asphaltenes to agglomorate & precipitate
  - Stability can be upset by :
    - Thermal stress
    - Adding paraffinic material/reducing aromatics
    - Mixing with other fuel



Courtesy of Prof. J. Murgich

0,50 % S max. fuel oils

- Compatibility : a measure of how stable a mixture is of two or more different components in a given ratio ➔ tendency to form organic sediment when commingling different fuel oils, leading to filter clogging, purification problems, ….
- Compatibility : not guaranteed by fuel supplier
  - Seggregation of different fuel batches
  - ASTM D4740 “spot test” not always reliable
- CONCAWE has sponsored test program to investigate whether test methods currently only routinely used by refiners, can provide additional information on the stability and guidance on potential instability of different fuel formulations and blends thereof.

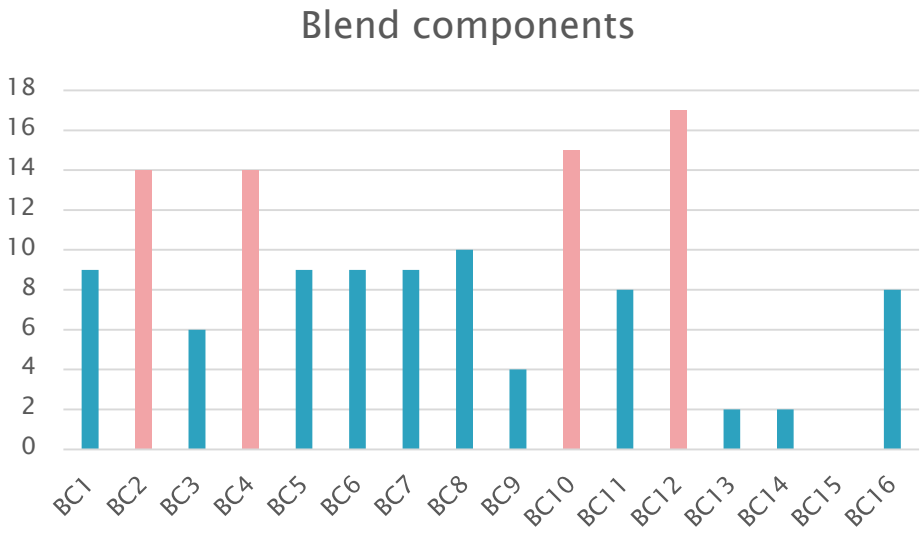
CONCAWE sponsored study

- 48 fuel oils tested:
  - 7 ULSFO (S ≤ 0,10 %)
  - 4 LSFO (S between 0,50 and 1.00%), 11 HSFO
  - 26 VLSFO (S ≤ 0,50 %)

straight run atmopsheric residue (HS or LS)	Residues from crude atmospheric distillation with no further processing
straight run vacuum residue (HS or LS)	Residues from crude vacuum distillation with no further processing
thermally cracked residues (HS or LS)	Residues from thermal cracking units (e.g. visbreaker unit, thermal gasoil unit)
catalytically cracked residues (HS or LS)	Residues from Fluid Catalytic Cracker (e.g. slurry oil)
hydroprocessed residues	Residues subject to sulfur reduction via hydrogenation
hydrocracker bottoms	Waxy residual stream from hydrocracker unit, coming from distillate feeds (e.g. VGO)
straight run atmosperic distillates	Distillate fractions from crude atmospheric distillation (e.g. straight run gasoil)
straight run vacuum distillates	Vacuum Gasoil from crude vacuum distillation (VGO) - also after mild hydrotreatment
thermally cracked distillates	Distillate fractions from thermal cracking units (e.g. VBU, TGU)
catalytically cracked distillates	Distillate fractions from Fluid Catalytic Cracker (e.g. LCO)
hydrocracked distillates	Distillate fractions from hydrocracker unit (no residues as feed)
hydrotreated distillates	Distillate fractions from hydrotreating unit
Pyrolysis Fuel Oil	Residue from ethylene cracker
Pyrolysis Gasoil	Gasoil fraction from ethylene cracker
Biocomponents	components coming from biomass processing (e.g. FAMEs, HVO, pyrolysed bio-oil)
Other	streams that do not fit the descriptions above

CONCAWE sponsored study

- 48 fuel oils tested:
  - 7 ULSFO (S ≤ 0,10 %)
  - 4 LSFO (S between 0,50 and 1.00%), 11 HSFO
  - 26 VLSFO (S ≤ 0,50 %)



BC2: Residue from crude vacuum distillation with no further processing
BC4: Residues from FCC (eg slurry oil)
BC10: Distillate fraction from FCC
BC12: Distillate fractions from hydrotreating unit

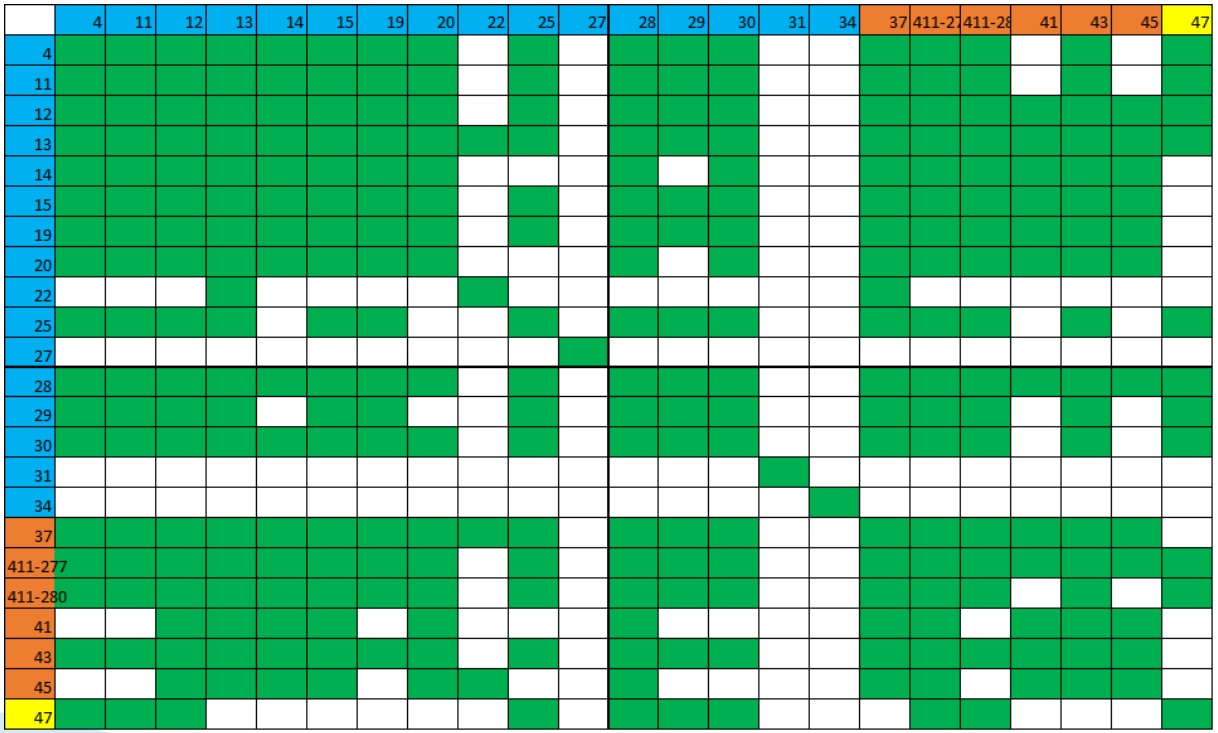
CONCAWE sponsored study

- All samples tested according to ISO 8217
- Additional test methods used:
  - ASTM D4740 “spot test”
  - Test methods involving a titration of a solution of the sample in an aromatic solvent with a paraffinic solvent, until asphaltenes precipitation is detected by an optical method
- Based on individual sample results, selected blends of fuels have been tested for their compatiblity & test results of selected methods compared with prediction methodology

CONCAWE sponsored study

- Compatibility prediction model indications:
  - Green: compatible over the entire 0-100 % commingling range
  - Blank: compatible within specific commingling ratio, eg: 10:90

HSHFO
LSFO
VLSFO



CONCAWE sponsored study

- Considerations:
  - A fuel shall have sufficient reserve stability
  - TSA ~ TSP: still valid for future fuels ?
  - Impact of waxy product streams in the blend on TSA, TSP, TSE and spot test
    - Routine tests may incorrectly indicate fuels to be unstable or incompatible, which however remains on the preferred side of caution.
  - How does the predicted compatibility compares to the individual fuels characteristics such as :
    - Density, pour point
    - CCAI
    - Viscosity

In summary

- Risk of fuel incompatibility can be mitigated by segregation of fuels
- Crew awareness of received fuel quality/properties becomes more important
- Supplier may be able to provide compositional information that may help to evaluate the potential risk for incompatibility
- PAS 23263 aims to provide mean(s) to obtain guidance on fuel compatibility that may involve additional testing
- Based on limited data set, methodology applied in the study showed approx. 50 % of the blends to be compatible over the entire mixing ratio
- Statistical analysis of the data set of the study ongoing

Thank you