What are the problems associated with bunkers?

- Fuel management
- Sampling
- Onboard handling
- Storage
- Fuel treatment

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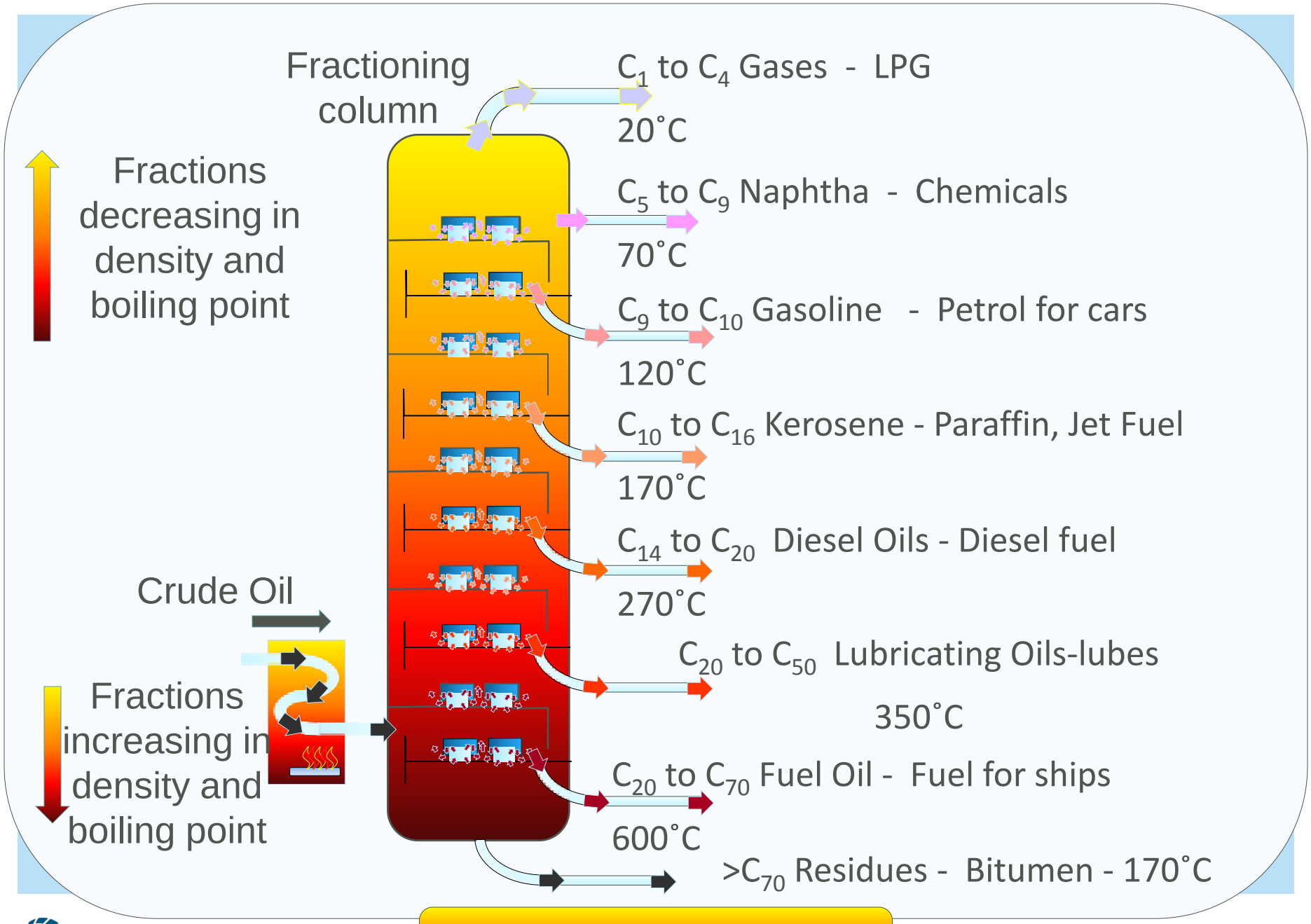
What do we mean by BUNKERS?

- **Bunker fuel is any type of fuel oil used onboard ships.**
- **The word “bunker” refers to a container that fuel is stored.**
- **Historically steam engine powered ships had coal bunkers.**
- **Now the fuel is stored in bunker fuel tanks.**



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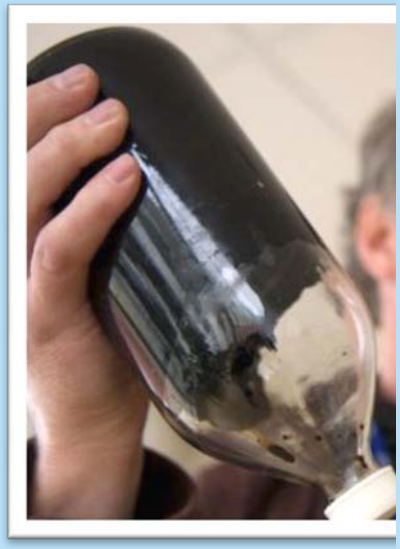
Distillation Column

Types of fuel bunkers



Residual Fuel Oil

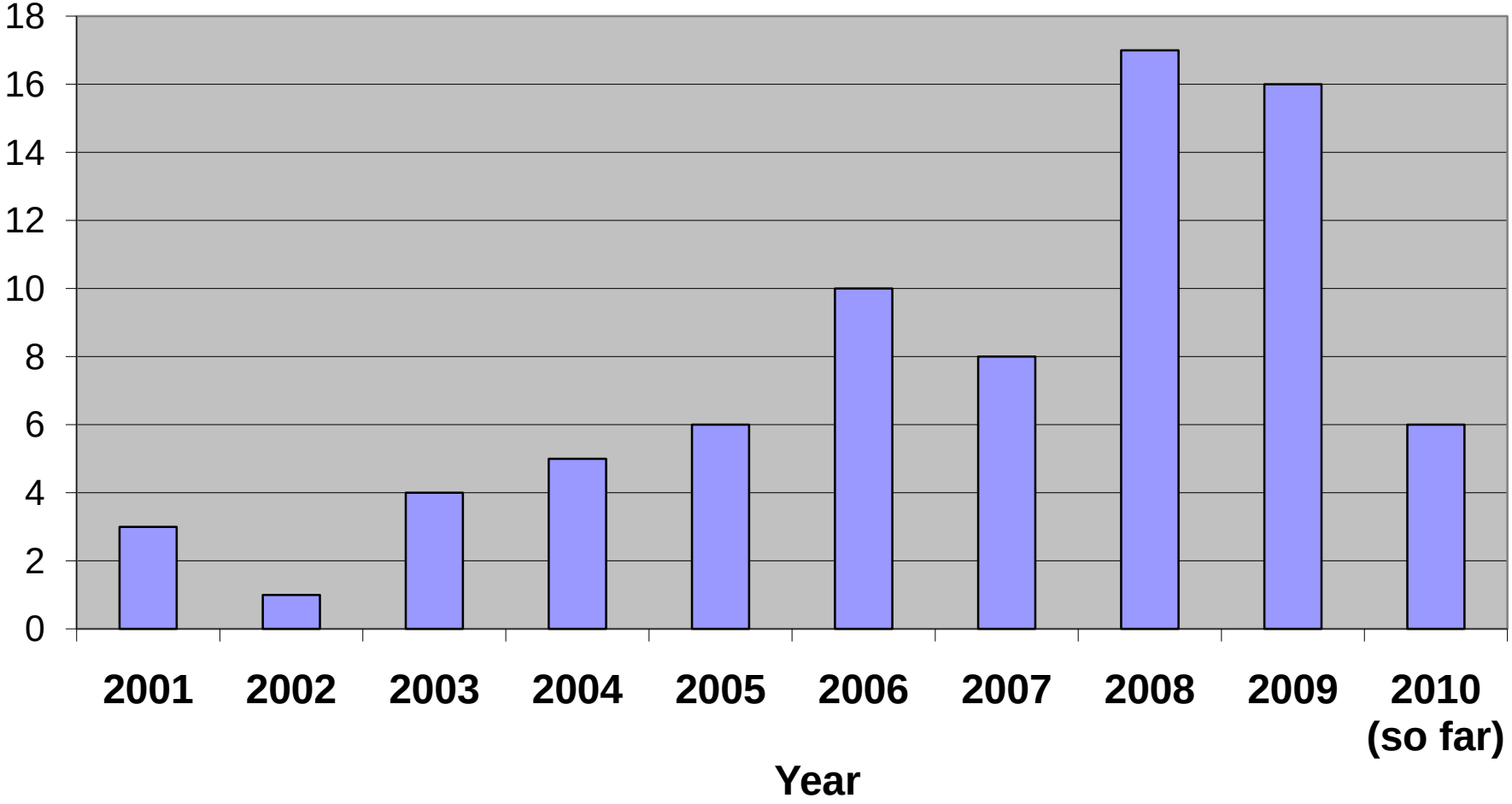
- Heavy Fuel Oil
- High Viscosity
- Black in colour
- Requires heating before use

Distillate Fuel Oil

- Marine Gas Oil or Diesel Oil
- Low Viscosity
- Clear in colour
- Can be used without heating

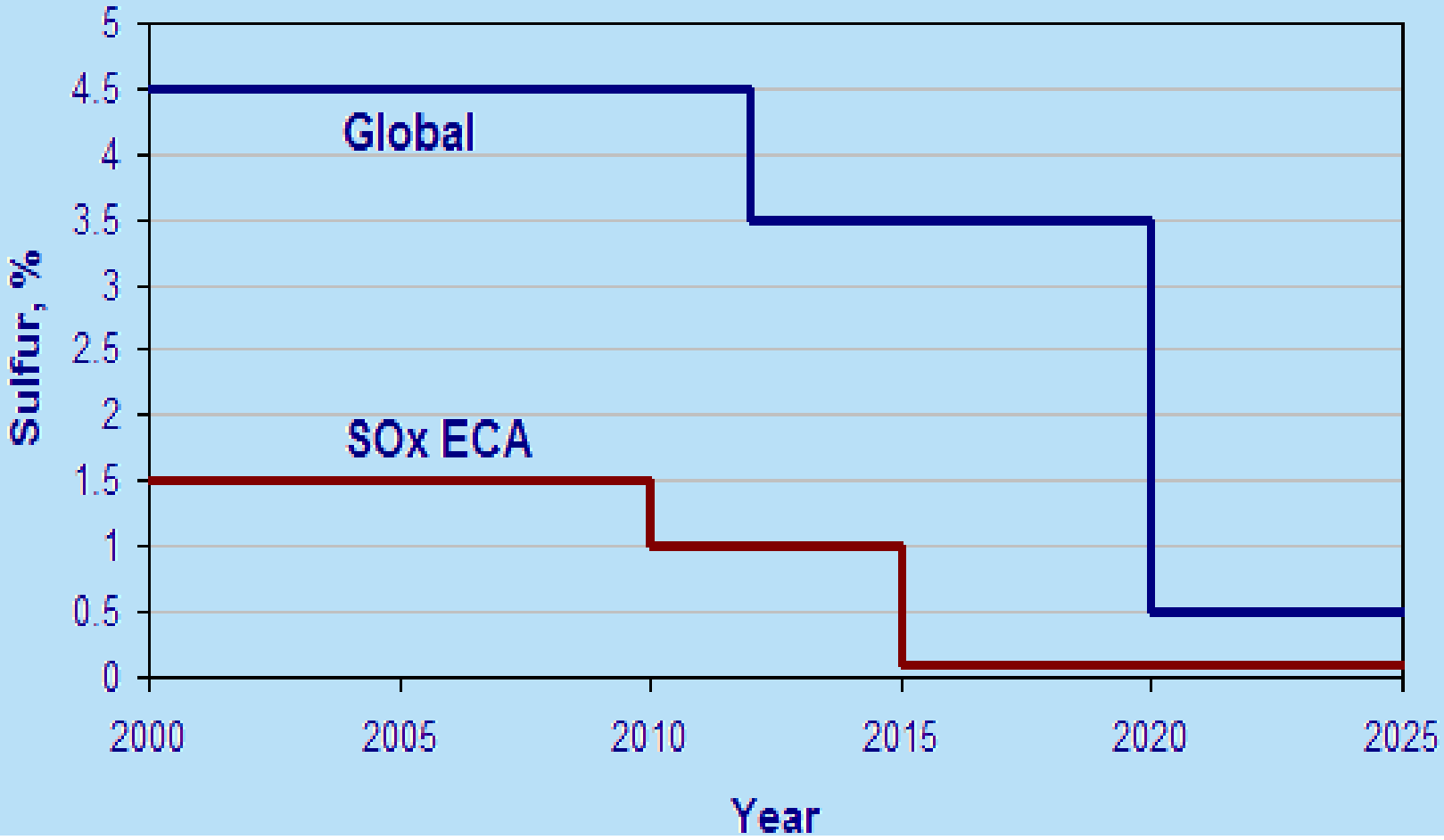
Number of Fuel Quality Related Cases

*(based on surveyors' responses in **May 2010**)*



Marine legislation up-date January 2010

MARPOL Annex VI Fuel Sulphur Limits



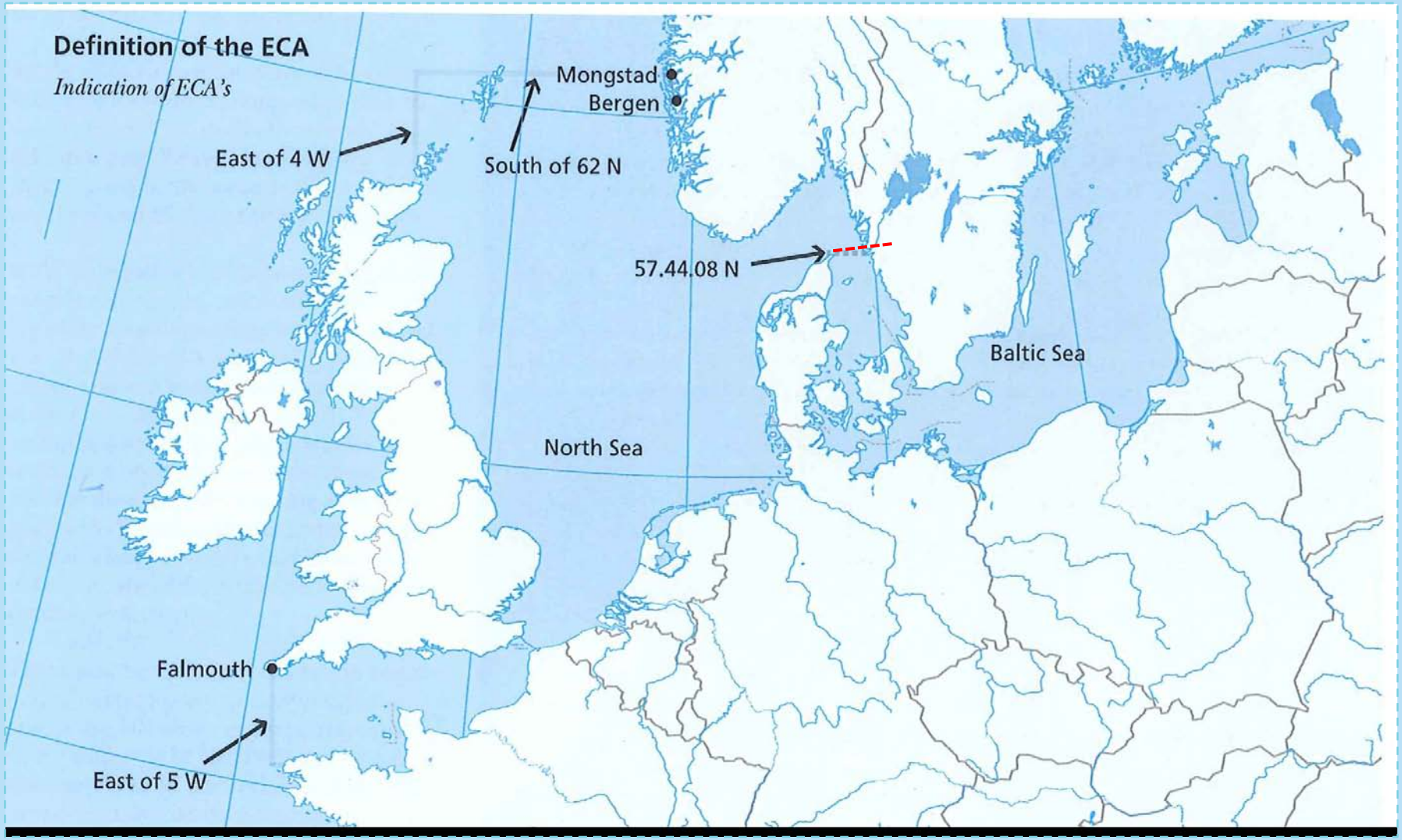
Marine Legislation up-date January 2010.

Legislation to enter into force 1st July 2010.

EU Directive 2005/33/EC extends the scope of EU Directive 1999 / 31& 32 / EC:

- This requires ships to use 1.00% sulphur fuel in the English Channel, North Sea, and Baltic, (designated Emission Control Areas)(ECA).
- They can burn 1.50% sulphur fuel in the Mediterranean and potentially 4.50% outside EU territorial waters.
- Requires them to either carry three types of fuel increasing number of changeovers and <u>opportunities for errors</u>.
- Or, to run on 1.00% Sulphur Fuel in all the Mediterranean which will be more expensive.
    - (if the fuel is available)?

Environmental control areas



USA area proposed for ECA designation

From 1 January 2010

- A 0.1% sulphur limit applies to all marine fuels for use by ships at berth for more than 2 hours in EU territory.
- This applies to all fuels used onboard.
  - in auxiliary engines
  - main engines
  - boilers.
- It was thought that vessels would hook up to shore power.
  - this is not practical
  - very large demands for power such as cruise ships.

Bunker manifold on deck

Note no drip sampler fitted.

Bunkering quality testing sampling kits

In line fuel sampling device.

Approved sealed bottle.

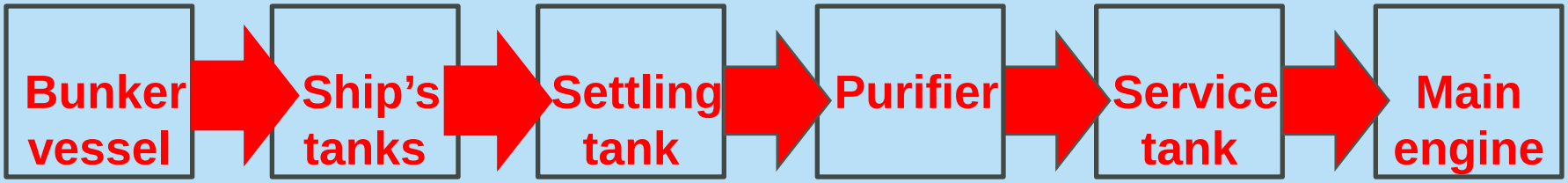
Bunkering a ship

Number of storage tanks

- **On board the majority of FO is kept within 2 to 6 tanks.**
- **Upon receipt the FO is put into one or two of these tanks.**
- **Bunkered FO should kept apart from the FO remaining on board (ROB).**
  - to avoid possible incompatibility problem.
- **The location is always subject to following considerations.**
  - type of fuel
  - volume
  - stability concerns
  - heating

Engine room settling tank

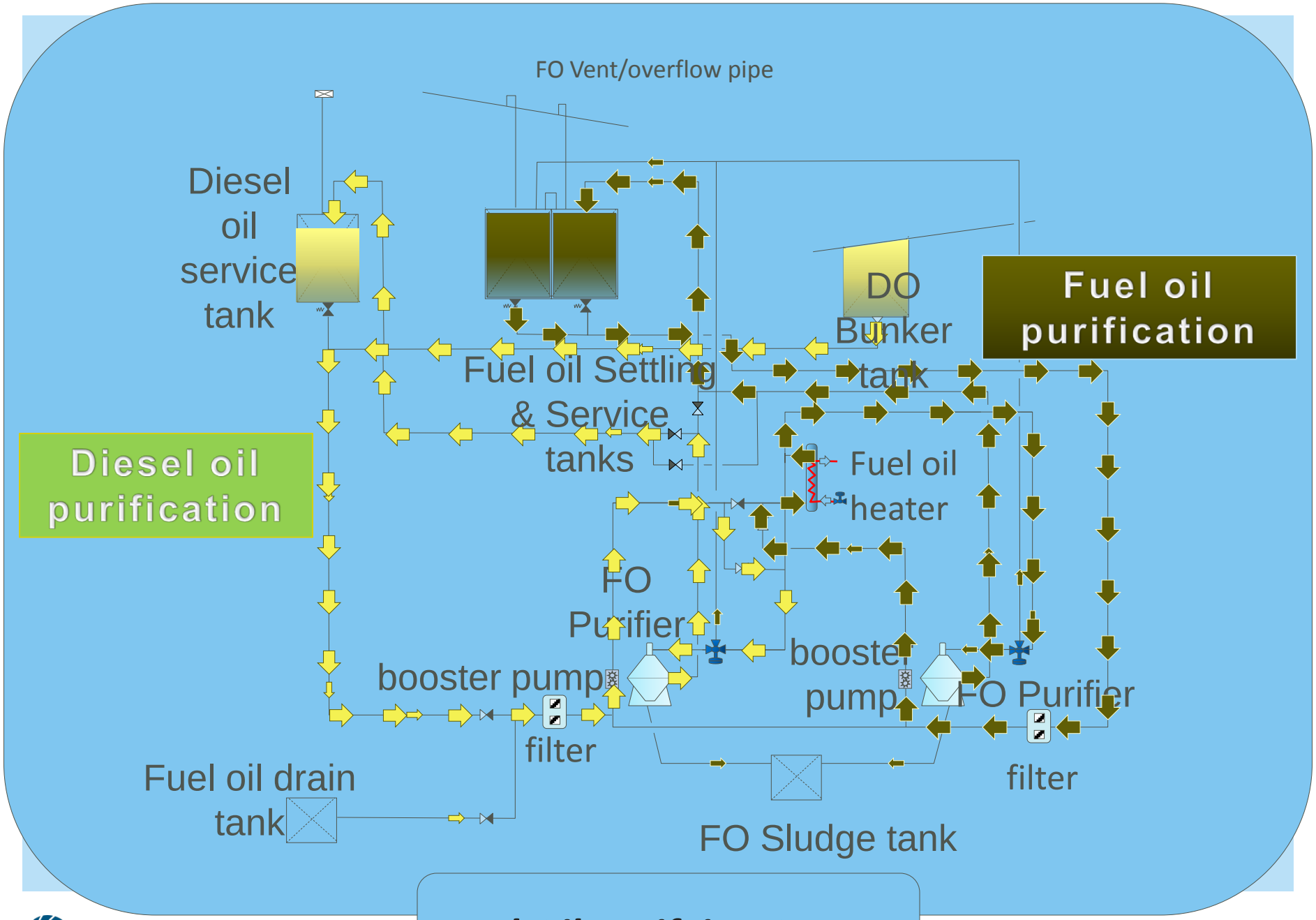
- Engine room settling tank is heated and the convection currents gently homogenise the oil in the tank.
- Concurrently water and solids settle out, by gravity.
- Water and sludge is drained off into the ship's sludge tank.
- Sediments have to be manually removed. Typically at planned maintenance or survey.



Purification

- Separates intermixed water from oil whilst also removing solid impurities.

- The lighter purified oil, the major part of the mixture, is fed to the daily service tank



Fuel Oil Purifying System

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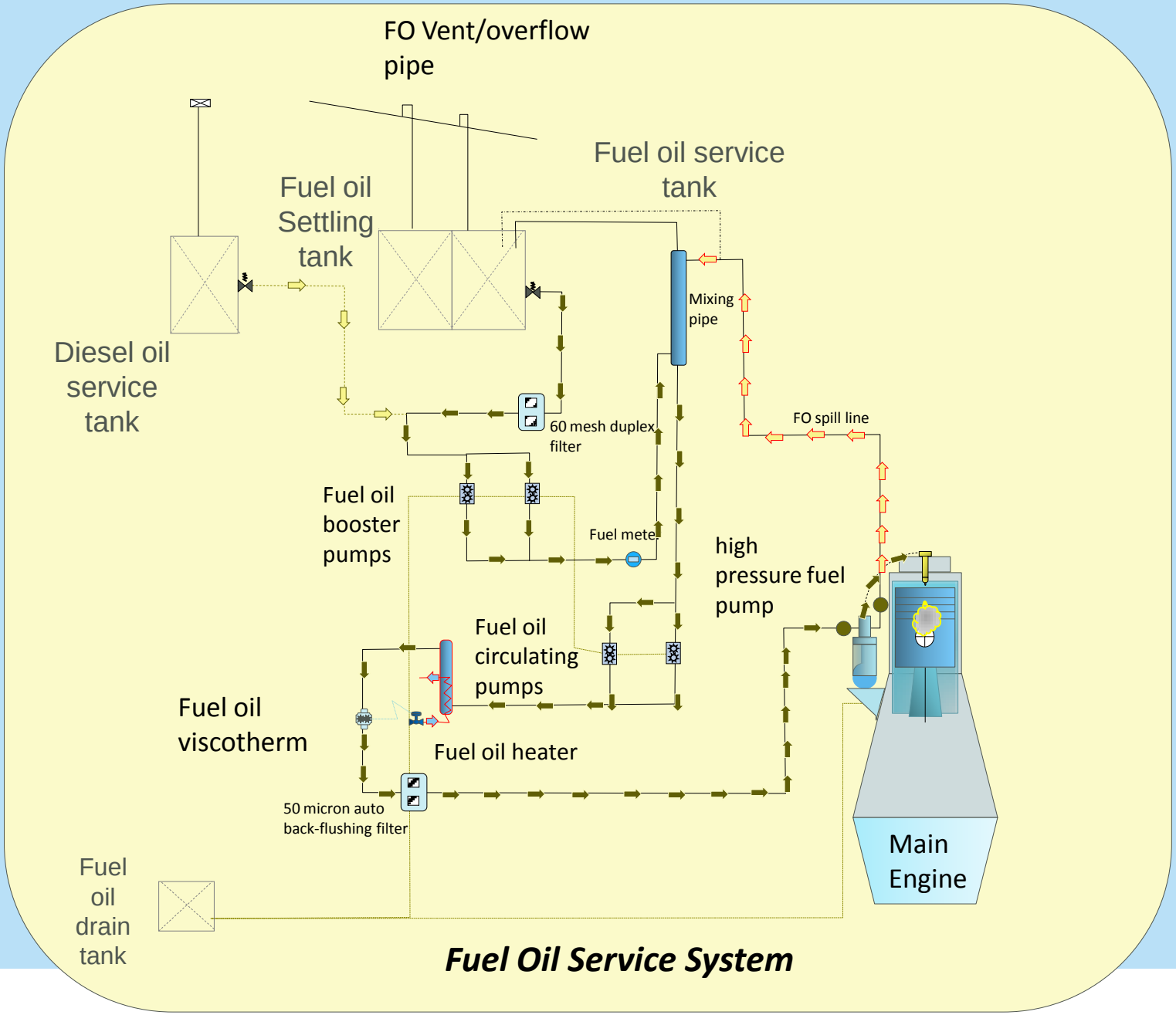


Fuel Oil Service System

Fuel properties – Problems associated

1. High viscosity
2. High specific gravity
3. High Conradson carbon residue (CCR Value)
4. High sulphur content
5. High ash content
6. High vanadium content
7. Sodium (salt water)
8. Incompatibility
9. Low flash point

Fuel properties - Problems

10. High Aluminium / Silica (catalyst fines)

Causes rapid and excessive wear on:-

- **piston rings & ring grooves**
- **cylinder liners**
- **fuel injection pumps and injectors**

FUEL ANALYSIS - Case study

Subject: Report: F060983210 – "Vessel" RMG 380: Conforms - EFN: 59

Fuel Sample

VLC Log No.	F060983210
Date	09/13/06
Bunk. Port and Date	Gibraltar, - 09/09/06
Place and Date Sent	09/11/06
Supplier	Aegean
Date Received at VLC	09/13/06
Sample Type per Customer	IFO 380
Grade	RMG 380
Tamper Proof	013098 : Sealed

Customer furnished data:

Density	973.9 kg/m3
Quantity	7300 M.Tons

Case study – specified parameters for RMG 380

Density @ 15 degC	972.1 kg/m3	(991.0 Max)
API Grade	13.98	(11.20 Min)
Viscosity @ 50 degC	315.60 cSt	(380.00 Max)
Viscosity @ 100 degC	30.8 cSt	(35.0 Max)
Upper Pour Point	10 deg C	(30 Max)
Carbon Residue	10.94 %wt.	(18.00 Max)
Ash	0.036 %wt.	(0.150 Max)
Water	0.15 %vol.	(0.50 Max)
Sulphur	1.48 %wt.	(4.50 Max)
Sediment	0.05 %wt.	(0.10 Max)

Case study

Calorific value	*40.91 MJ/kg*
Minimum Transfer Temperature	*41 degC*
Injection Temperature (For 13 cSt Viscosity)	*130 degC*
*Engine Friendliness Number (**EFN: 1-100**)*	***59***

<u>Grade Conformance</u>

The fuel sample tested conforms to grade RMG 380.

Case study – *Note the Al + Si readings*

Vanadium	*52 wt.ppm*	*(300 Max)*
Al + Si	***55 ppm***	***(80 Max)***
Flash Point	*> 65 degC*	*(60 Min)*

<u>Additional Parameters</u>

Silicon	***26 Ppm***
Aluminium	***29 ppm***
Sodium	*19 ppm*
Calcium	*5 ppm*
Iron	*32 ppm*
Lead	*< 1 ppm*
Nickel	*26 ppm*
potassium	*< 1 ppm*
Zinc	*1 ppm*
Magnesium	*1 ppm*
Calcium carbonate CCAI	*835*

Case study - Cat fines

Comments

High iron noted. High iron can cause damage to fuel pump and fuel nozzle. Ensure purification and filtration systems are functioning efficiently.

Suggestions & Recommendations to Ship Owners/Operators/Technical Staff.

Temperature for injection viscosity 10 is 142°C.
Temperature for injection viscosity 15 is 124°C.

Catfines

Observation: Catfines content (Aluminum +Silicon) in fuel is high. Catfines cause high wear in rubbing surfaces of cylinder and fuel system. If the catfines content is less than 15 ppm, wear and tear for the engine will be minimal. Increased catfines content will increase the wear rate.

Purify continuously and recirculate the fuel several times to bring down the catfines content.

Case study - Cat fines

Pour Point

Observation: Heat and store this fuel at 10°C above the measured pour point temperature.

Sulphur

Observation: This fuel has low sulphur. High alkalinity of some cylinder oils can cause scuffing and excess wear of cylinder liners.

Make sure cylinder oil used can handle low sulphur fuel.

Overall Quality

Engine Friendliness Number (EFN) is a unique bench-mark of fuel quality evaluated by VISWA LAB from the point of view of engine wear and tear resulting from the use of this fuel. Based on EFN, which is calculated from the analysis results listed in this report, the quality of this fuel is above average.

Case study - Cat fines

Case study - Cat fines

Case study - Cat fines

Damaged cylinder liner

Cylinder liner surface 100 times magnification

Shiny dots show evidence of aluminium cat fines embedded.

Other Contaminants

- Recently an alert was sent out by a P&I Club regarding fuel contaminated by styrene, DCPD, and phenols.
- Used lubricating oil waste is reoccurring problem that has occurred around the world.
- We recently had another case where waste products from the cosmetic industry!

Cases we are currently involved in

- Claim involving IFO fuel containing styrene and (DCPD) causing main and auxiliary damage to fuel system components.
- Claim of high water content in the fuel, vessel stoppages, loss of hire, towage, de bunkering, GA claim and engine repair costs.
- High asphaltenes and carbon residues causing engine damage.
- Claim involving high (Total Acid Number) and (Strong Acid Number) values with alleged acid attack and increased wear on components.
- Claim involving fuel which has been analysed with elements of used lubricating oil causing engine damage.
- High values of CCAI (Calcium Carbonate) causing injection delays, combustion problems and associated engine contamination and damage.

Chemical waste such as polyethylene found in fuel

One of the affected pistons removed due to contamination

Bunkers today - Tricks of the trade

- We have never been present at a bunkering where the receiving vessel received more than was ordered.

Density difference

- Marine fuel is sold by weight and delivered by volume.
- Density measurement is essential.
- The density on the supplier's Bunker Delivery Note (BDN) is often proven to be incorrect in the supplier's favour.

Viscosity difference

- If a 180 cSt viscosity fuel is ordered, but a 380 cSt viscosity fuel is incorrectly received there is a commercial implication.
- Higher viscosity fuels are cheaper so receiver is overcharged.

Bunkers today - Tricks of the trade

Water content

- If higher than specified this will result in more water and less fuel.
- Water costing US$ 500 to 1000 a ton is to be removed.
- Also reduces the fuel's specific energy.

Questionable calibration tables

- Calibration tables can be adjusted to favour the supplier.
- Look for an endorsement by a recognised authority.

Bunkers today - Tricks of the trade

Introduction of air

- Aerated bunkers when sounded give the impression that an adequate amount has been delivered.
- Two days later once the entrained air has disappeared a short fall is discovered.
- Described as the cappuccino effect.

Pumping of slops into bunkers from hidden tanks

- Hidden slops can be delivered as bunker fuel introducing contaminants and reducing the amount of fuel delivered.

HOW DO WE PREVENT FUEL PROBLEMS?

MANAGING FUEL

- Needs to be strict controls.
- Specify requirements.
- Ensure good sampling to check that you get what was specified.
- Fuel analysed before it is used.
- Technical managers study the analysis before authorising use.
- Clear instructions to Engineers about fuel handling onboard.
- Regular inspection of handling onboard.
- Fuel bunkered to an empty tank and isolated before use.

Preventative measures

Checks prior to bunkering

- **Details of marine fuel oil supplier recorded.**
- **Product name (which should agree with the fuel ordered).**
- **Quantity in metric tonnes.**
- **Density & sulphur content stated.**
- **A declaration signed by the fuel oil supplier that the oil supplied conforms with regulations 14 and 18 (sulphur and ULO content).**

Preventative measures

Checks prior to and during bunkering

- Record every significant event from arrival of barge to its departure including photographs.
- A note of protest should be issued if there are any doubts or any events which may later be considered significant.
- Ensure safe access using a SOLAS approved ladder so there are no excuses for either party not to visit each other's vessel.
- Witness sounding and measuring of temperatures of the bunker barges tanks even the empty tanks and sludge tanks.
- Witness soundings or ullages and inspect the sounding tape.

Preventative measures

Checks at completion of bunkering

- **Upon completion of bunkering and to ensure quantity**
  - **resound all tanks on both vessels.**

- **Upon completion and agreement of quantities**
  - **ensure all the samples are sealed and endorsed**
  - **and photographed in the presence of both parties.**

- **Record own vessel and barge's draft marks before and after the event.**

Preventative Measures

Checks prior to and during bunkering

- **BDN includes the seal numbers of the samples taken.**

- **At least 3 preferably 4 samples should be collected:**
  - ships retained sample
  - Marpol Annex VI sample
  - sample for testing
  - supplier's sample.

- **The sample for testing must be dispatched for testing immediately.**

Why do samples matter?

- **Samples are the most vital aspect of any bunkering quality dispute.**
- **All analysis techniques and points of law regarding claims for substandard quality require representative samples.**
- **Only way of assessing what was received on board the vessel at the point of transfer, the ship's manifold.**

Not a difficult problem you might think!

It should not be but it very often goes wrong.

- **The objective of sampling should be**
  - **to obtain a representative sample of the bunkers**
  - **that is witnessed jointly**
  - **agreed by the parties concerned.**

Sealed samples

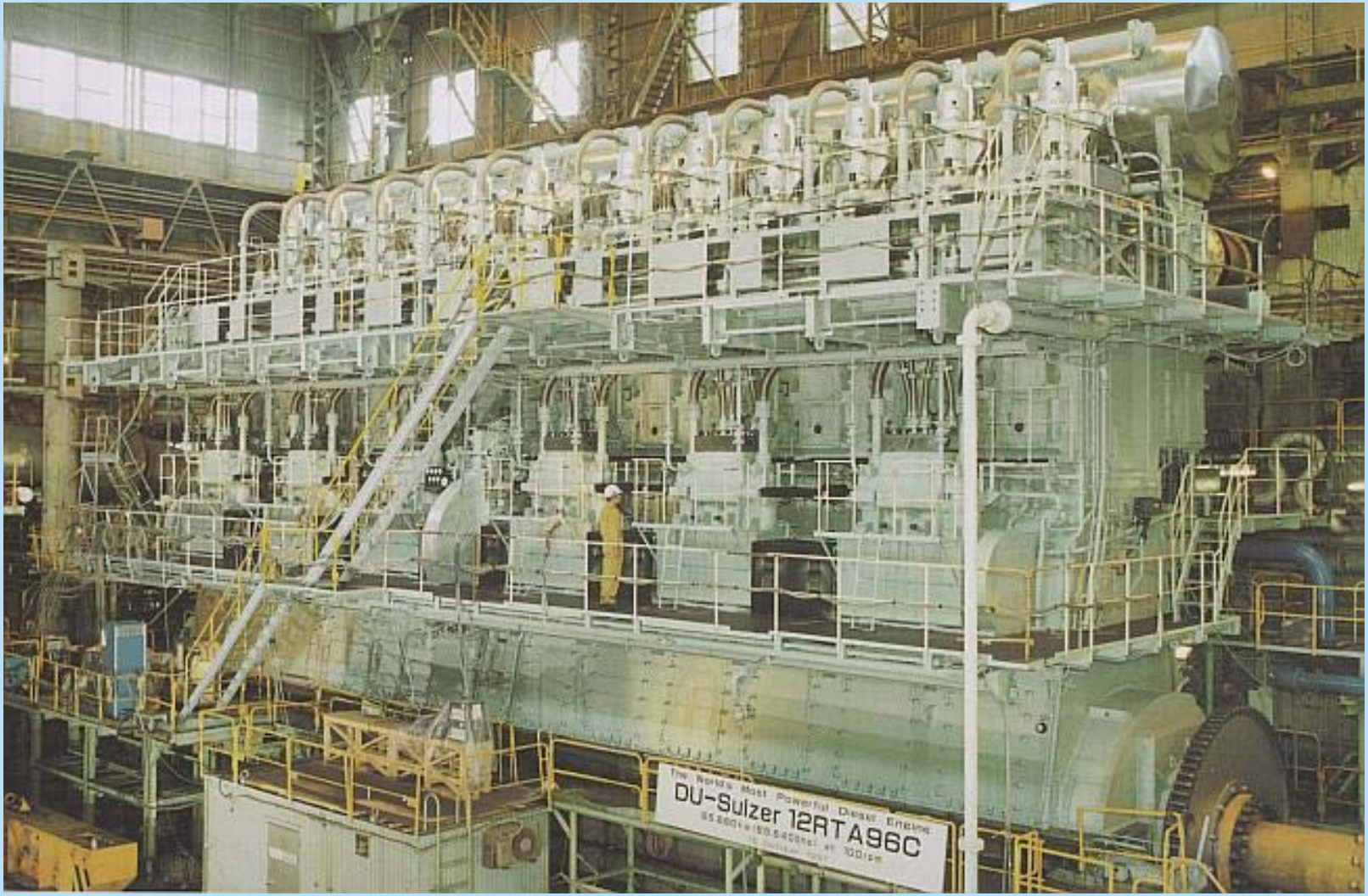
- follow company procedures
- use clean sample bottles
- note location, time and date
- name of bunker tanker
- name of vessel
- signatures and names of officers
- details of seal identification
- bunker grade

Representative samples

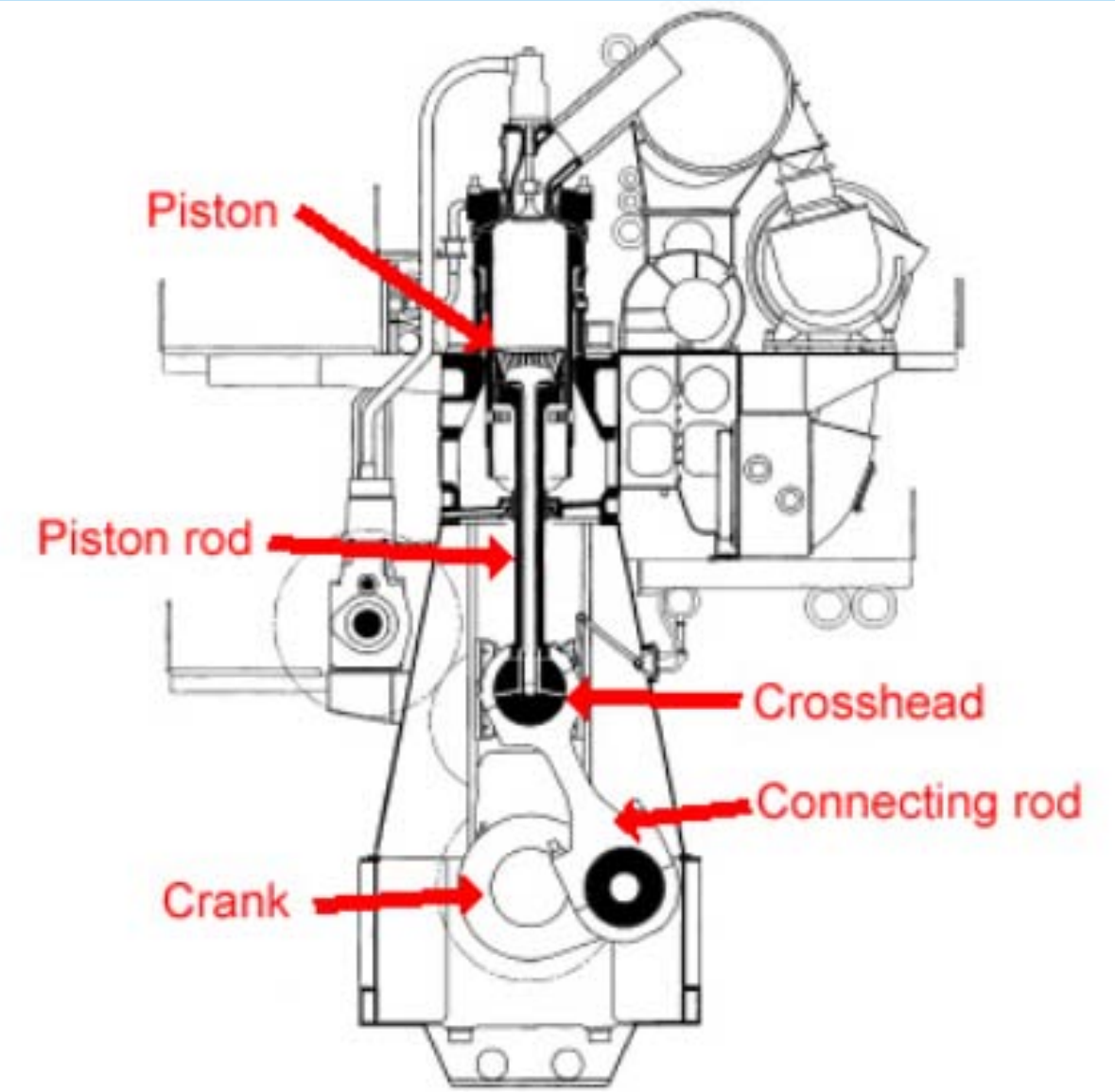
Fuel should be drawn off

- **at the start of fuel being received**
- **some time during the middle**
- **and near the end.**

Currently the biggest engine in the world.



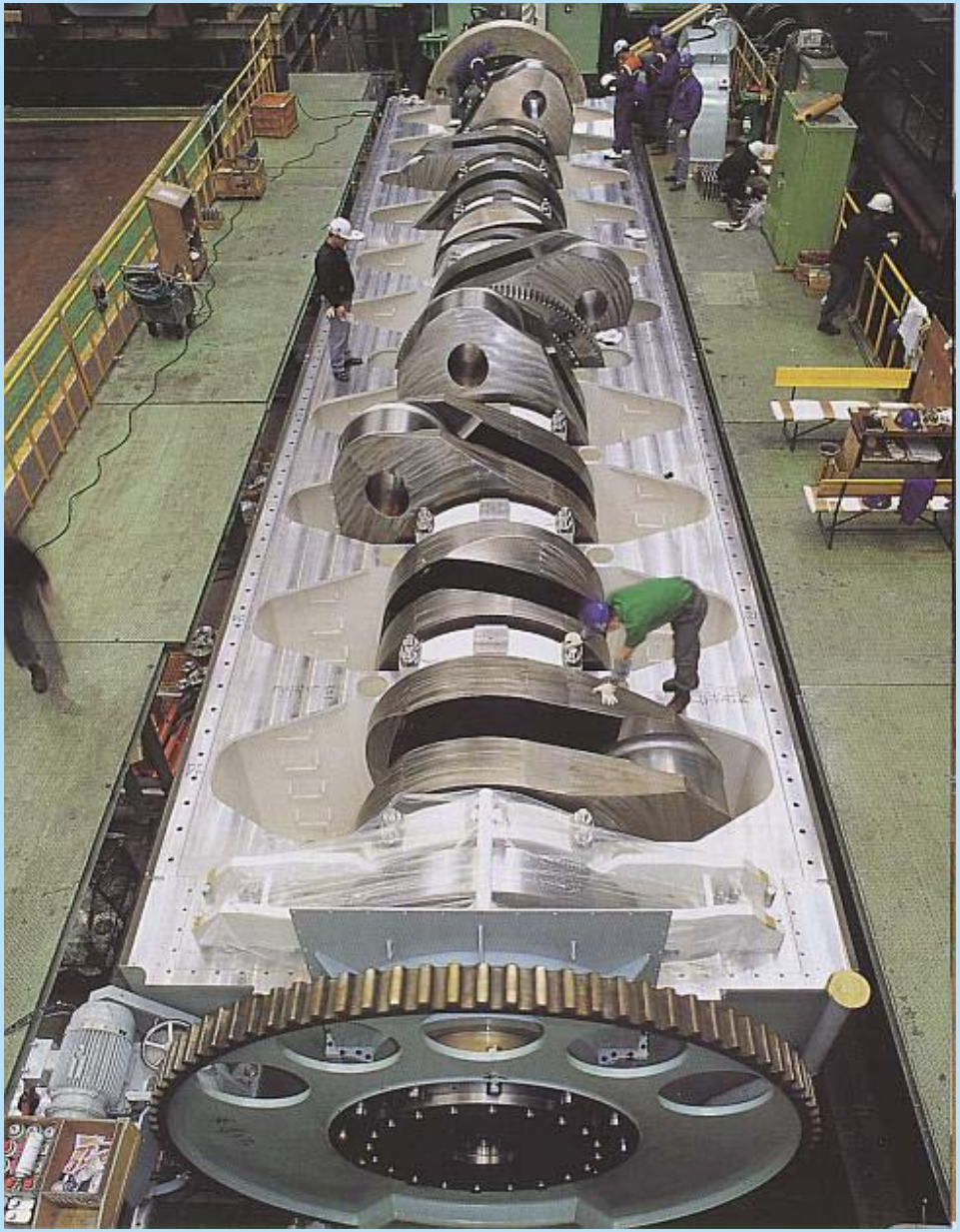
A cross section of the RTA96C:



Main engine piston and piston rod

Comparison height 2 metres

Crankshaft



Interesting facts & figures

- An engine of the size described costs about US$ 17,000,000
- Pollution from shipping worldwide measured in CO_2 values is about 2.7% in terms of emission per tonne of cargo transported. For instance a Panamax Bulk carrier emits 3g/t/km compared with a Boeing 747-700 which emits 540g/t/km
- Amount of fuel consumed by ships in SECA is estimated to be about 20 million tons per annum
- The real global warming threat is surely the population of the world which is currently 6.692 billion people and is expected to rise by 0.8 billion per decade or 80 million per year. Is this sustainable?
- In 1804 it was 1 billion. In 1950 it was 2.6 billion.

Slow speed steaming

- **Recognised that this is a potential problem if the manufactures guidelines are not followed.**
- **Have not seen any cases yet.**

Lay - up.

Resulting damages due to lay up

- We have seen a number of damages due to vessels bumping into each other at congested anchorages.
- We have seen vessel that have run aground in storm conditions due to inappropriate lay up position.
- LNG in lay-up with a 48,000bhp steam plant. Someone thought it a good idea to leave the covers off the main condenser, but didn't think to check that there was more than single valve isolation to the sea. Cost estimate 37.5 million.
- Crew used a paint-can lid as a blank on a 300mm seawater pipe with a 7metre head of seawater above. They then went to bed. The engine room flooded to the 10metre level within 10hours. Estimated cost US$ 21 million.

And finally...

Thank you for listening

THE SALVAGE ASSOCIATION

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