Bunkers & Cat Fines

The current issues and what the future might look like

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Managing Director
Europe & Africa

What are bunkers?

Bunker fuel is a name for any type of fuel oil used on board ships.

The word “bunker” refers to a container where fuel is stored.

Historically steam engine powered ships had coal bunkers.

Now the fuel is stored in what we call bunker tanks.

Where does bunker fuel come from?

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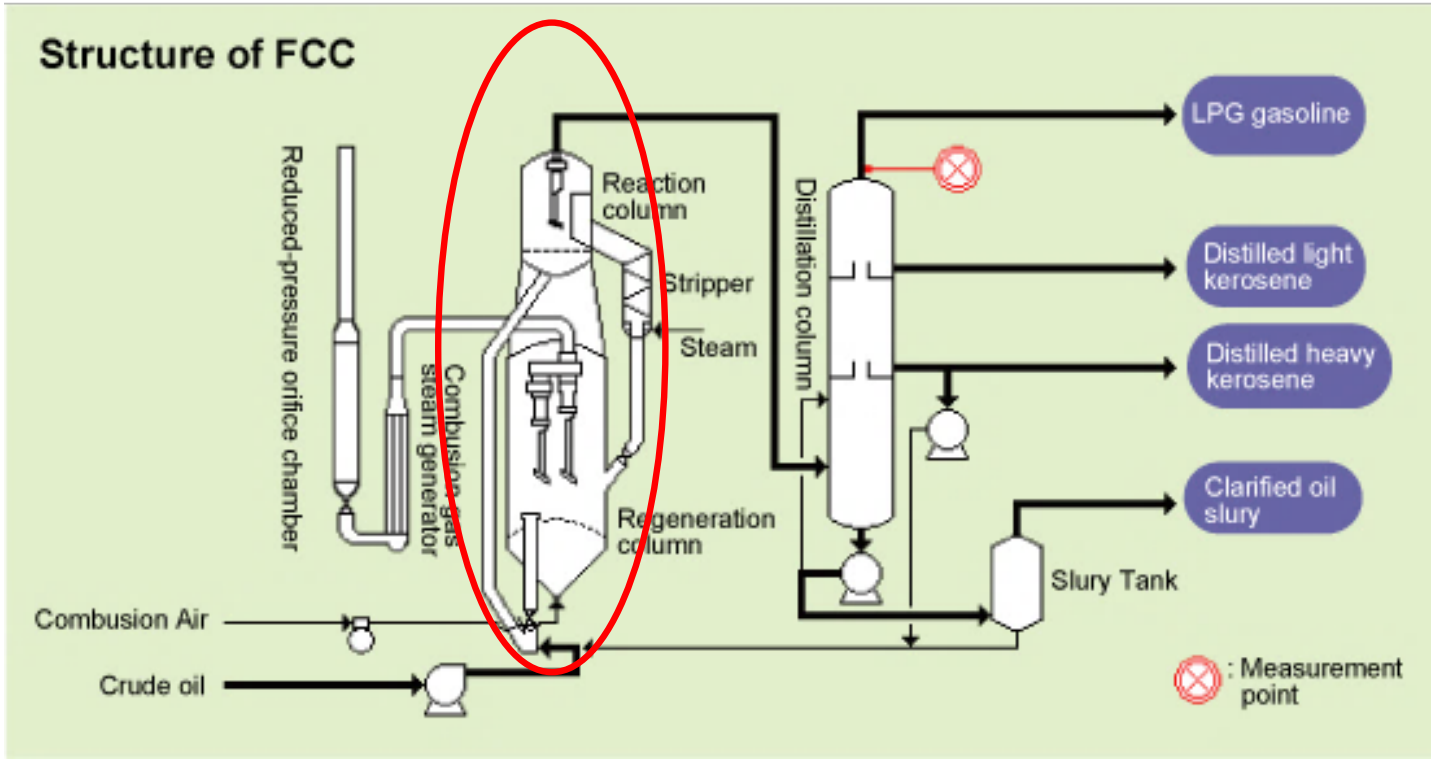
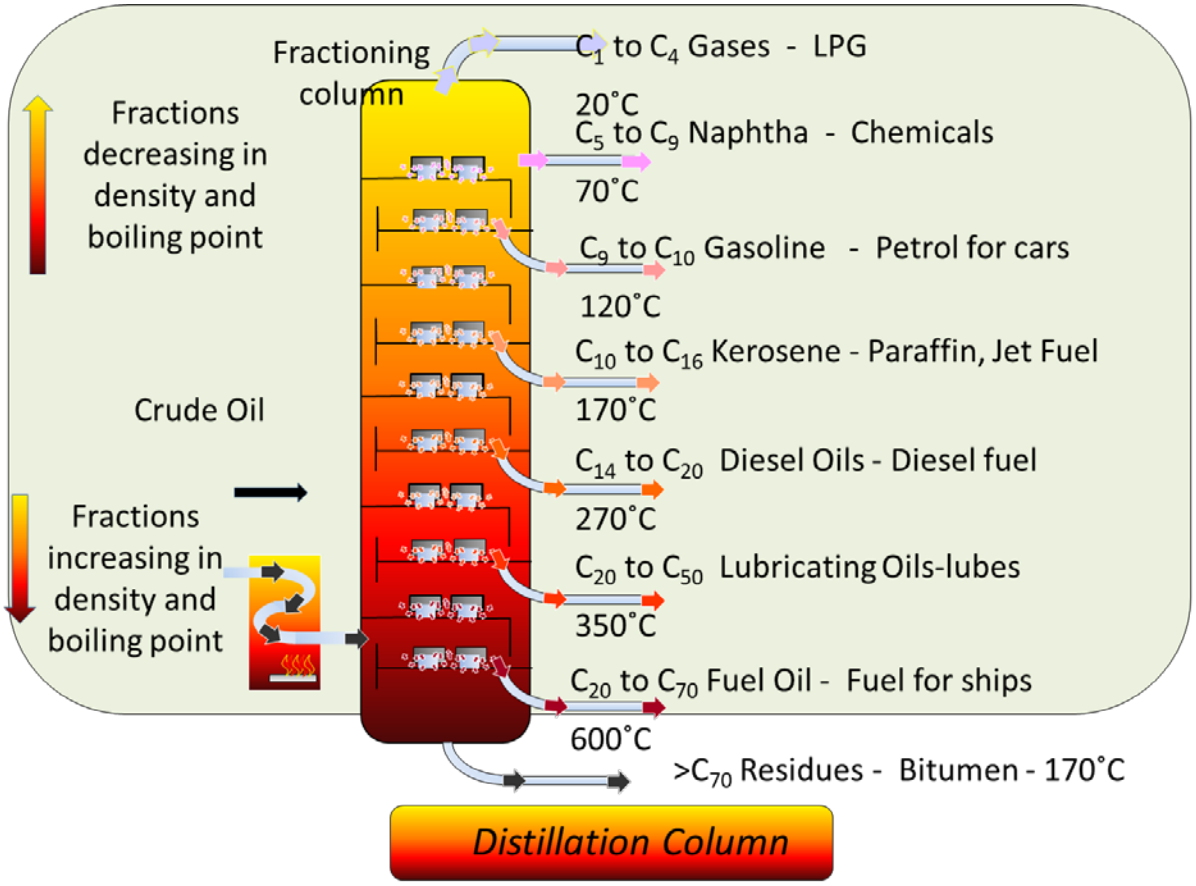
How does it happen?



An Oil Refinery Fluid Catalytic Cracker (FCC)

Then what happens?



What are the different types of fuel?

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

What are the common contaminates?

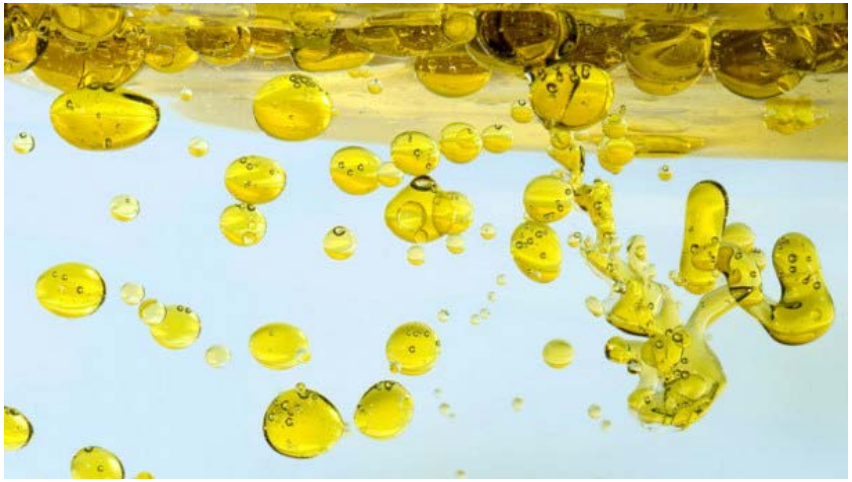
Water	• Sea water, chlorides • Fresh water • Dissolved water
Particulate matter	• Solid corrosion (rust) • Cat fines • Organic compounds (dirt, fibres)
Chemicals	• Waste oil • Waxes • Paint products
Microbes	• Bacteria • Algae • Fungi

What effects do these contaminates have?

Let's have a closer look.....

Water contamination

- Engine fuel system component failure
- Poor combustion
- Failure to start
- Can facilitate corrosion and acid erosion
- Quantity problems…



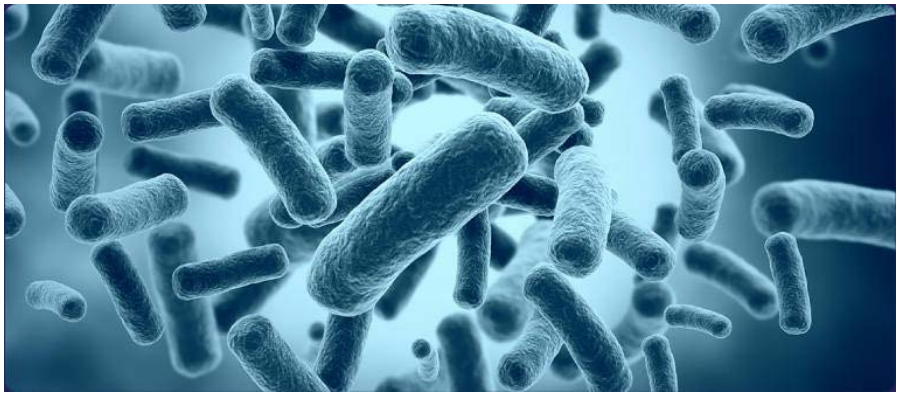
Chemical contamination

- Can cause instability of the fuel
- Effects viscosity and density
- Poor combustion
- Deposits in engine
- Corrosion

Microbial contamination

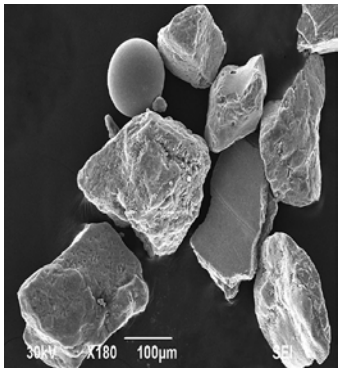
- Forms biomass particles clogging filters

  Organic acid production causing corrosion
- Poor combustion
- Health hazards

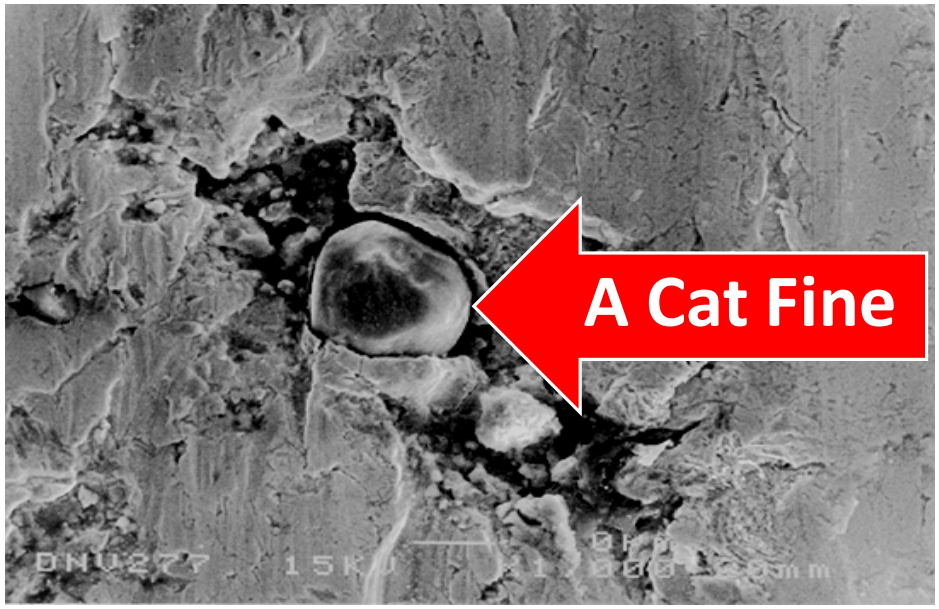


Particulate matter

- **Rust is common causing filter blockage**
- **Catalytic fines causing severe engine wear and early failure.**



Catalytic fines

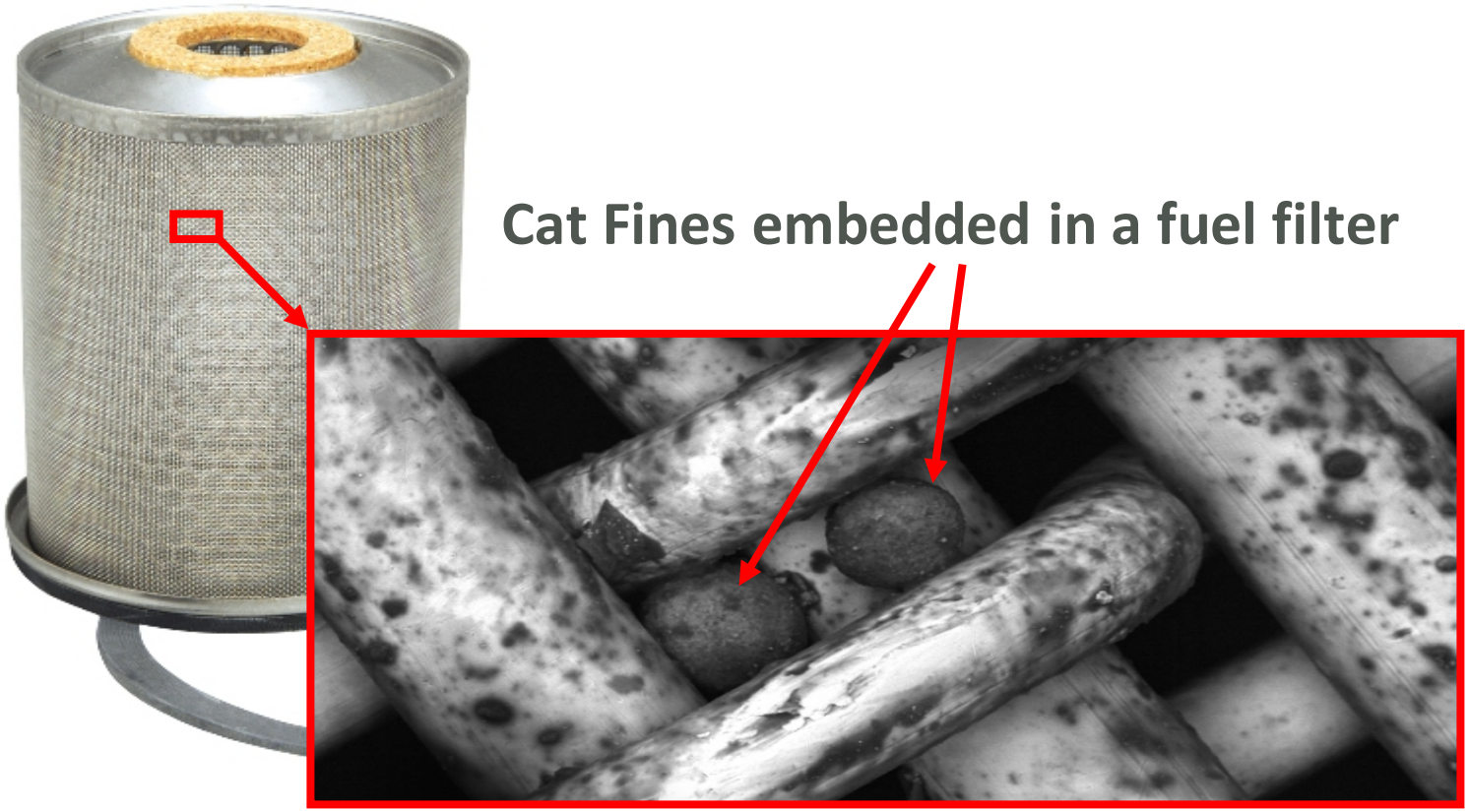


What are Cat Fines?

Catalytic Fines (from here on known a Cat Fines)

- Hard Ceramic Compounds of Aluminium and Silicon,
- Used as a catalyst in the crude oil refining process,
- To enable higher yield of distillate fuels to be extracted from the stock
- The process is called catalytic cracking.
- The cat fines are expensive and are mostly recovered and used again, however small quantities may be carried over with the residual fuel

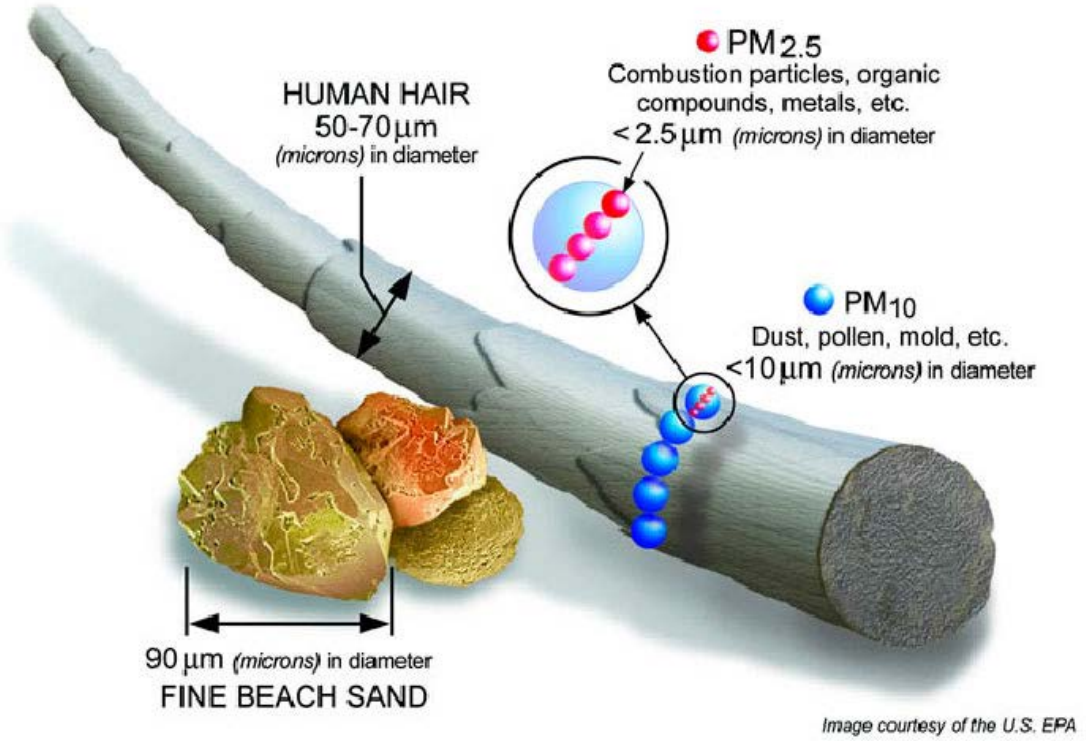
How big are Cat Fines?



Cat Fines embedded in a fuel filter

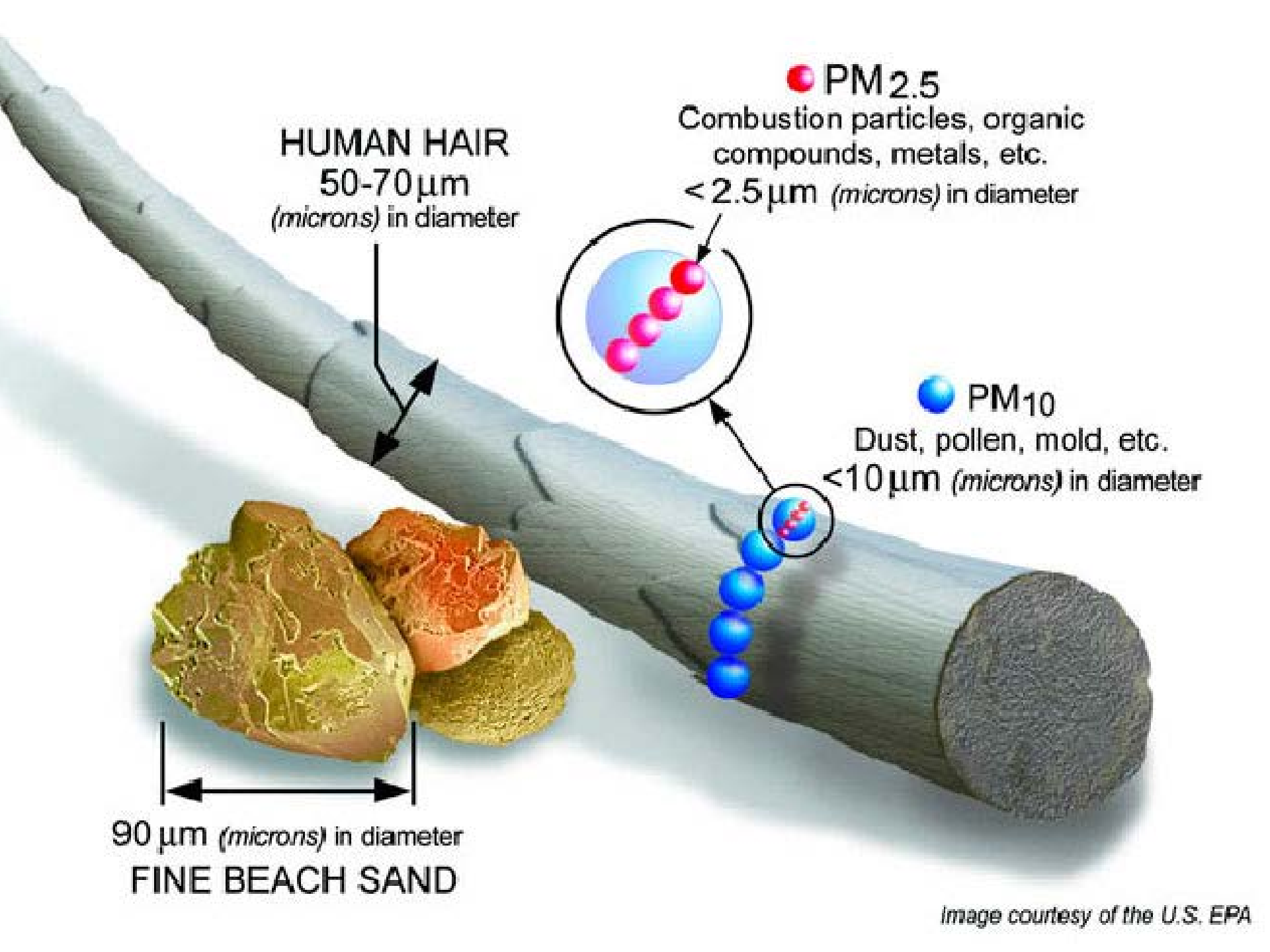
How small are Cat Fines?

75 µm down to 1 µm



1 µm (micron) = 0.001 mm

25 µm


PM2.5
Combustion particles, organic compounds, metals, etc.
<2.5 µm (microns) in diameter
HUMAN HAIR
50-70 µm
(microns) in diameter
PM10
Dust, pollen, mold, etc.
<10 µm (microns) in diameter
90 µm (microns) in diameter
FINE BEACH SAND
Image courtesy of the U.S. EPA

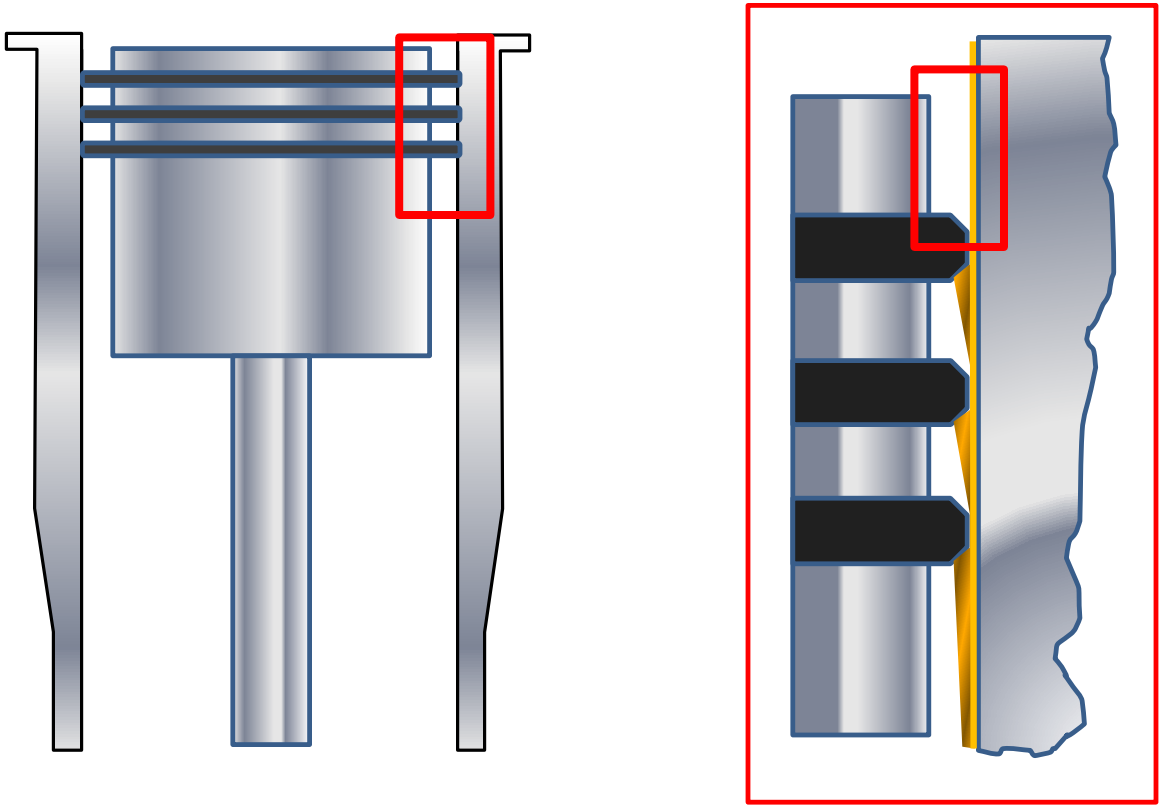
What do Cat Fines do to an engine?

They get embedded into engine components and cause abrasive wear;

- The main components affected are cylinder liners and piston rings
- Can affect fuel pumps, injectors and valves
- In extreme cases piston rods and stuffing boxes

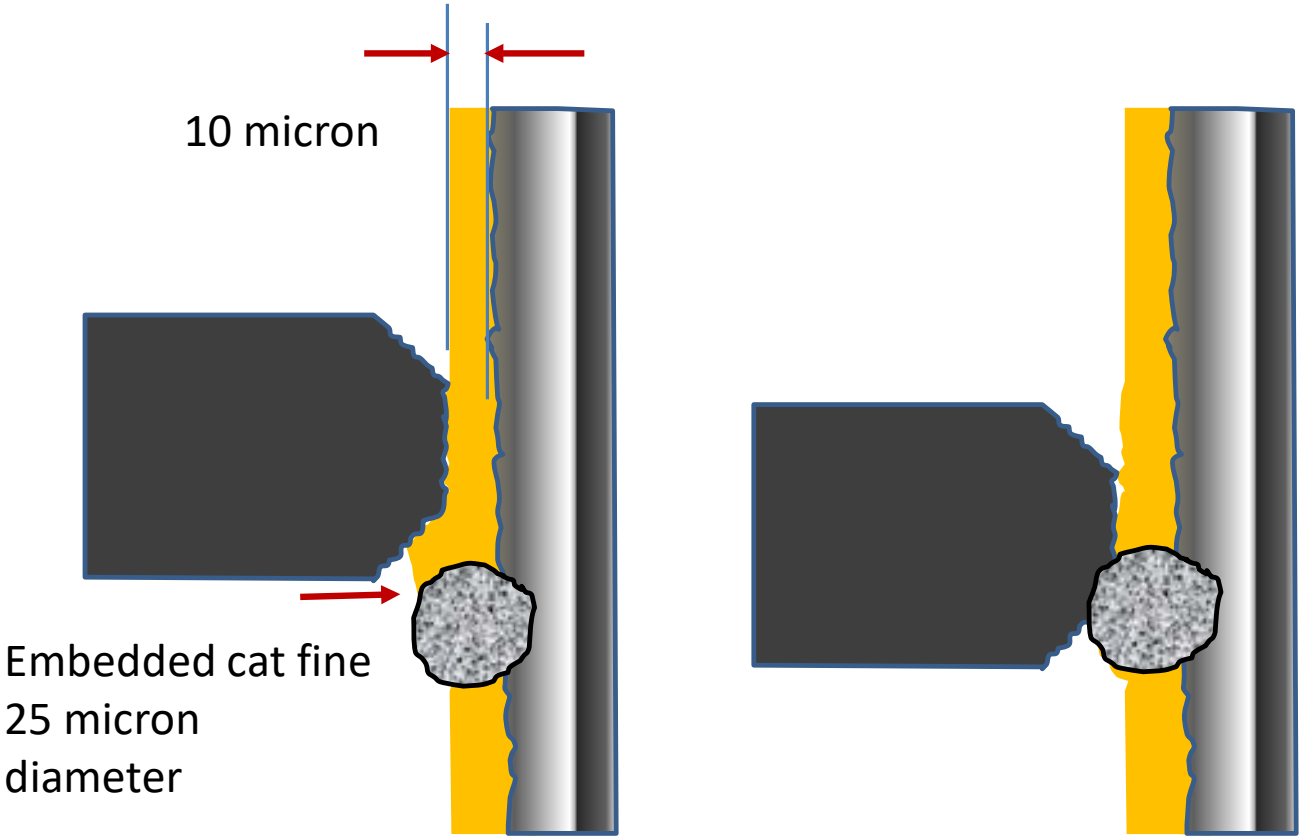
Why are cylinder liners vulnerable to cat fines?

Piston in a cylinder liner



Close up view of the cylinder oil lubrication

The effect embedded cat fines have



Who cares about all this anyway?

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I guess you already know? It's you!

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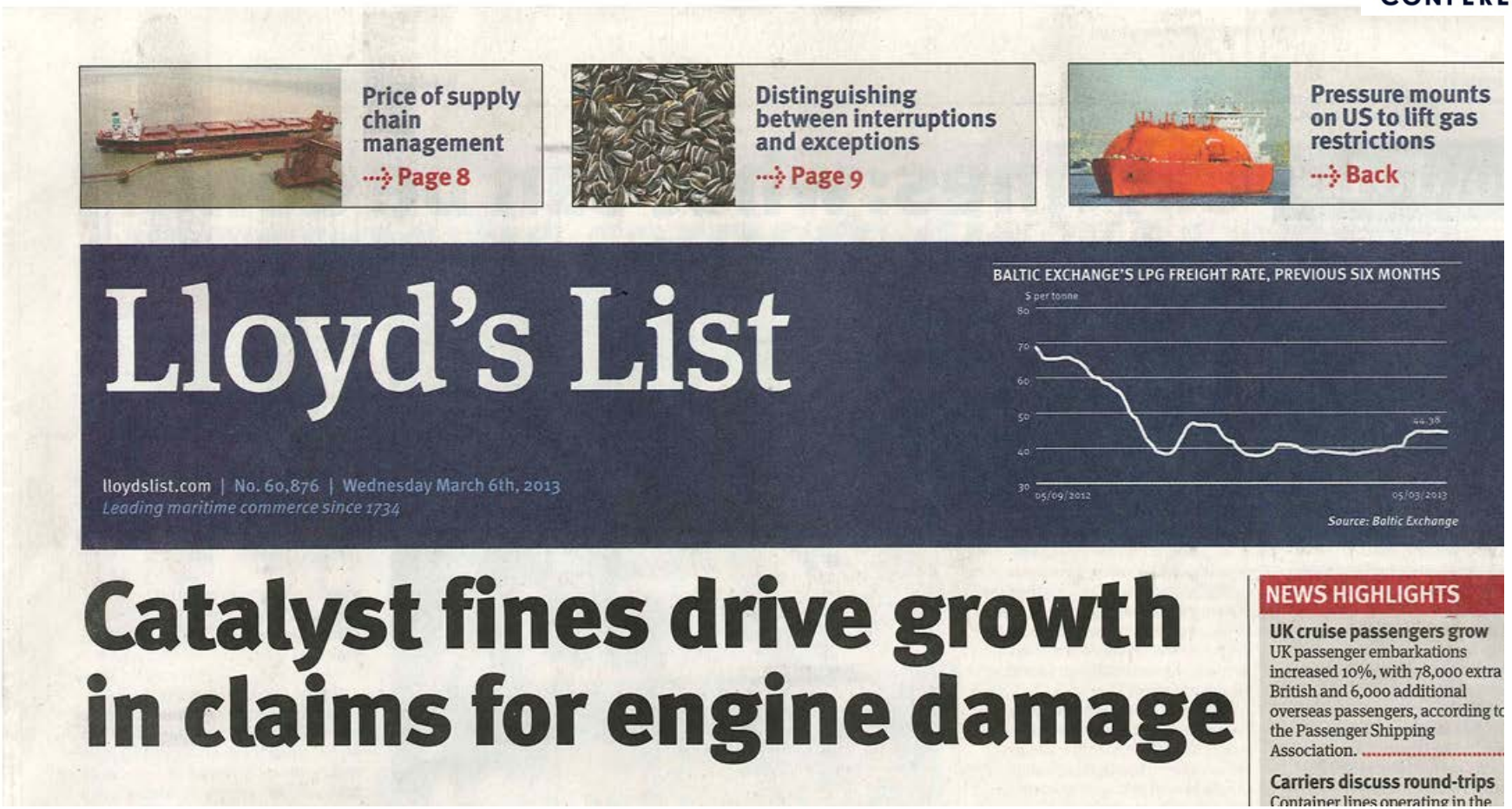
Insurance Claims?

Types of insurance that may be relevant to fuel contamination/ quality and how…

- **Hull & Machinery** Engine damage due to bad fuel may be recoverable
- **P&I** no direct cover, may cover delays and cargo damage due to machinery failures
- **Freight, Demurrage and Defence** cost of surveys and collection of evidence , legal costs for prosecuting claim against supplier or time charterer
- **Bunker Insurance** covers de-bunkering, tank cleaning, time and fixtures lost
- **Loss of Hire** what it says on the box

Headlines in 2013



Price of supply chain management
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Distinguishing between interruptions and exceptions
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Pressure mounts on US to lift gas restrictions
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Lloyd's List

lloydslist.com | No. 60,876 | Wednesday March 6th, 2013
Leading maritime commerce since 1734

BALTIC EXCHANGE'S LPG FREIGHT RATE, PREVIOUS SIX MONTHS
$ per tonne
80
70
60
50
40
30
44.38
05/09/2012
05/03/2013
Source: Baltic Exchange

Catalyst fines drive growth in claims for engine damage

NEWS HIGHLIGHTS

UK cruise passengers grow
UK passenger embarkations increased 10%, with 78,000 extra British and 6,000 additional overseas passengers, according to the Passenger Shipping Association.

Carriers discuss round-trips
Container lines operating in the

Nor Shipping News in 2017

“Cat fines threaten 43% of engines claims Exxon Mobil”

Iain White, global marketing manager, ExxonMobil

Are Cat Fines a New Problem? The answer to this is simply NO

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- **Up until the 1950's residual fuel oil was burnt in boilers, to create steam for turbines, the most common form of marine engine at the time.**
- **Large slow speed diesel engines slowly became popular in the 1960's and 70's as the ability to burn residual fuels improved.**
- **1973 Middle East War tripled the price of crude oil, refiners forced to squeeze more product from the crude stock.**
- **Catalytic Cracking processes developed**
- **1980's engine problems attributed to these Cat Fines started to be reported.**

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Early Warnings!

B&W Marine Service

Spare Parts & Technical Service

B&W

2 Tornegade
DK-1449 Copenhagen K
Telephone (0945-1-542501
Telex: Spare Parts 31197 bwpart dk
Technical Service 31151 bwserv dk
Purchasing 31195 bwpurc dk
Forwarding 19123 — 19042 bwforw i
Telegrams BWMARINESERVICE

Division of B&W Motor AS
Reg. No. 44787 - The
Burmeister & Wain Group

Founded 1843

Service Letter

Our ref

no. SL 77-117/EE

Date October, 1977

Fuel Oil Cleaning Procedure

Separator, Filter, and Homogenizer

Dear Sirs,

In recent years, the generally well-established procedure of centrifuging the fuel oil to remove water and solid particles, has, in a number of ships, tentatively been replaced by filtering and in some cases by homogenizing the oil, generally combined with filtering.

While the first modern filtering plants, which we have followed since 1968, seemed to give acceptable results, this was, however, not the case with bulk results from later installations, as cylinder wear rates in these generally rose to about 3 times the conventional figures or even more.

This increase in wear was confirmed by the fact that piston rings in ships with filter installations usually show a characteristic vertically-scratched running face, very rough on the upper rings and decreasing in roughness downwards.

This observation indicates that abrasive particles in these plants are intro-

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What can ship's staff do?

- **The ships engineers do not know if the fuel that they are using contains high level of Cat Fines until test results, if any are received onboard.**
- **All fuel received onboard should be treated as if it contains Cat Fines.**
- **The fitting of onboard Cat Fine analysis equipment or use of test kits should be considered.**

What are the problems?

The problems are many, such as, but not limited to:

- **Poor efficiency of purifiers (essential part of the onboard fuel treatment plant and a topic on it's own)**
- **Lack of knowledge of the current bunker fuel quality by the ships engineers**
- **Lack of good maintenance practices, such as regular cleaning of fuel tanks**
- **Minimal and insufficient capacity of purifiers provided by the shipyard during the build**

What else can be done?

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To reduce the risk of engine damage due to cat fines? and by who:

- **Owners and Managers**
- **Charterers**
- **Ships Crew**
- **Engine Makers/ shipbuilders**
- **Classification Societies**
- **New Technology**

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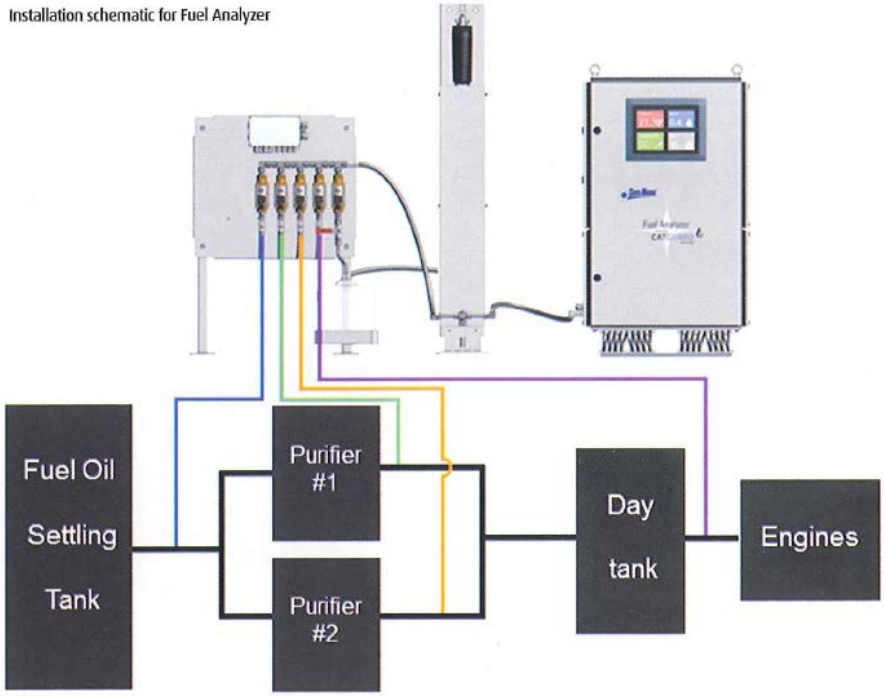
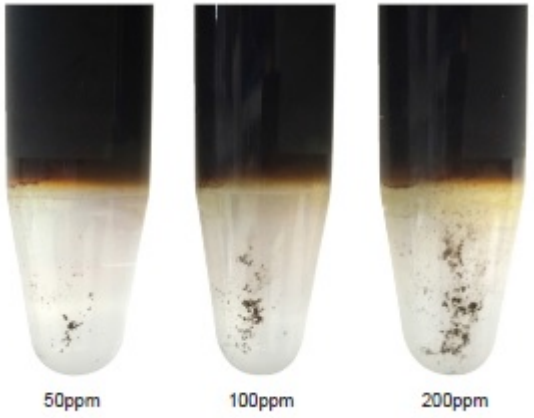
What is onboard analysis?



Has already been installed by a large shipping company with immediate positive results

What is onboard analysis?



Courtesy of Parker Kittiwake

Quality Standards

The International Organisation for Standardization

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ISO

Since 1982 have published a specification for marine bunker fuels specifying the maximum limits of various characteristic, components and contaminants.

The standard is known as ISO 8217 and is currently in it's fifth revision:

ISO 8217: 2012

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What does ISO 8217 do?

It defines a specific quality standard for marine fuel oil

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Characteristic	Unit	Limit	Category ISO-F- RMA	RMB	RMD	RME	RMG				RMK			Test method reference
			10	30	80	180	180	380	500	700	380	500	700	
Kinematic viscosity at 50 °C	mm^2/s	max.	10,00	30,00	80,00	180,0	180,0	380,0	500,0	700,0	380,0	500,0	700,0	ISO 3104
Density at 15 °C	kg/m^3	max.	920,0	960,0	975,0	991,0	991,0				1010,0			ISO 3675 or ISO 12185
CCAI		max.	850	860	860	860	870				870			Annex B
Sulphur	mass %	max.	Statutory requirements											ISO 8754 ISO14596
Flash point	°C	min.	60,0	60,0	60,0	60,0	60,0				60,0			ISO 2719
Hydrogen sulphide	mg/kg	max.	2,00	2,00	2,00	2,00	2,00				2,00			IP 570
Acid Number	mg KOH/g	max.	2,5	2,5	2,5	2,5	2,5				2,5			ASTM D664
Total Sediment Aged	mass %	max.	0,10	0,10	0,10	0,10	0,10				0,10			ISO 10307-2 Procedure B
Carbon residue, micro method	mass %	max.	2,50	10,00	14,00	15,00	18,00				20,00			ISO 10370
Pour point (upper) –winter quality –summer quality	°C	max. max.	0 6	0 6	30 30	30 30	30 30				30 30			ISO 3016 ISO 3016
Water	Volume %	max.	0,30	0,50	0,50	0,50	0,50				0,50			ISO 3733
Ash	mass %	max.	0,040	0,070	0,070	0,070	0,100				0,150			ISO 6245
Vanadium	mg/kg	max.	50	150	150	150	350				450			IP 501, 470 or ISO14597
Sodium	mg/kg	max.	50	100	100	50	100				100			IP 501 or 470
Aluminium plus silicon	mg/kg	max.	25	40	40	50	60				60			IP 501, 470 or ISO10478
Used lubricating oils (ULO)	mg/kg	-	The fuel shall be free from ULO. A fuel shall be considered to contain ULO when either one of the following conditions is met: Calcium > 30 and Zinc > 15; or Calcium > 30 and Phosphorus > 15											IP 501, 470 or 500

New Grade
New Parameters
Same as 2005
Changed Values

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ISO 8217 Cat Fine Limits

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HISTORY

Date		Version	CAT FINE LIMITS
1982	BS MA 100	first published	Not specified
1986	ISO 8217	published as BS MA 100:1986	Not specified
1996	ISO 8217	2nd edition	Max 80 mg/kg
2005	ISO 8217	3rd edition	Max 80 mg/kg
2010	ISO 8217	4th edition	Max 60 mg/kg
2012	ISO 8217	5th edition	Max 60 mg/kg

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So why is the limit not set lower?

MAN B&W, Wartsila and the other main engine makers specify a maximum of 15 ppm Cat Fines

The answer to this question is purely commercial, with refiners saying "yes we can produce 15ppm fuel oil, but it will cost you the customer more".

"any how, all ships are built with a fuel treatment system that is capable of removing the Cat Fines to a level below the 15 ppm stated by engine makers, so what's the problem"?

What else is being done?

The Joint Hull Committee convened in 2013 to produce Guidance Notes (JH2013/006) for the Mitigation of Engine Damage due to Catalytic Fines. These in conjunction with a increased emphasis on fuel treatment during a JH2013/10A warranty survey have increased ship owners awareness of the problem and how to address it.

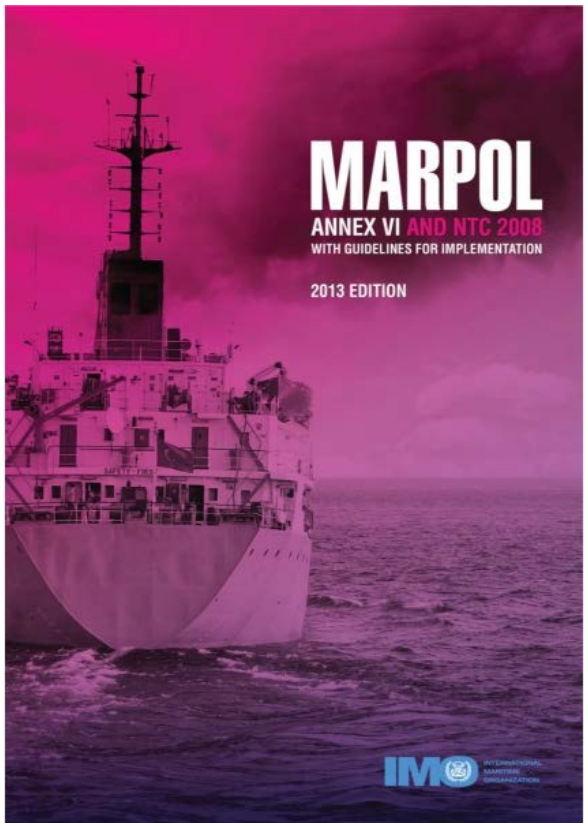
Lloyd's Market Association

...providing professional, technical support to the Lloyd's underwriting community

Future developments

The fuel oil Sox and Nox emission regulations have had and will have a significant impact on the future of shipping.

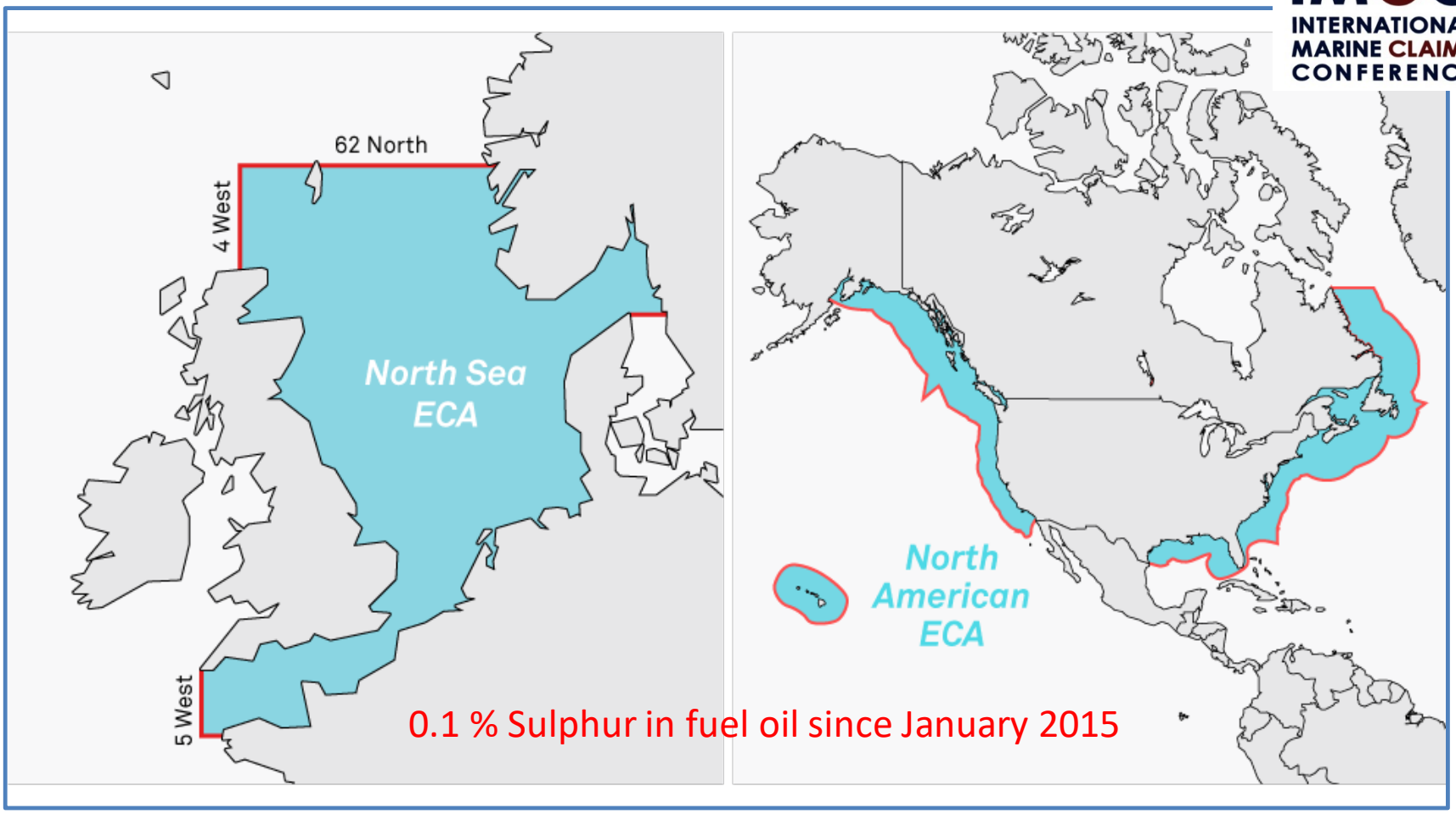
What are the sulphur standards set by IMO?



The Protocol of 1997 (MARPOL Annex VI)

- Sulphur emission control areas (SECA)
- Prohibition of ozone depleting gases
- Limits on nitrogen oxide emissions
- Prohibition of incineration of certain waste

Emission Control Areas



Marine Sulphur Limits

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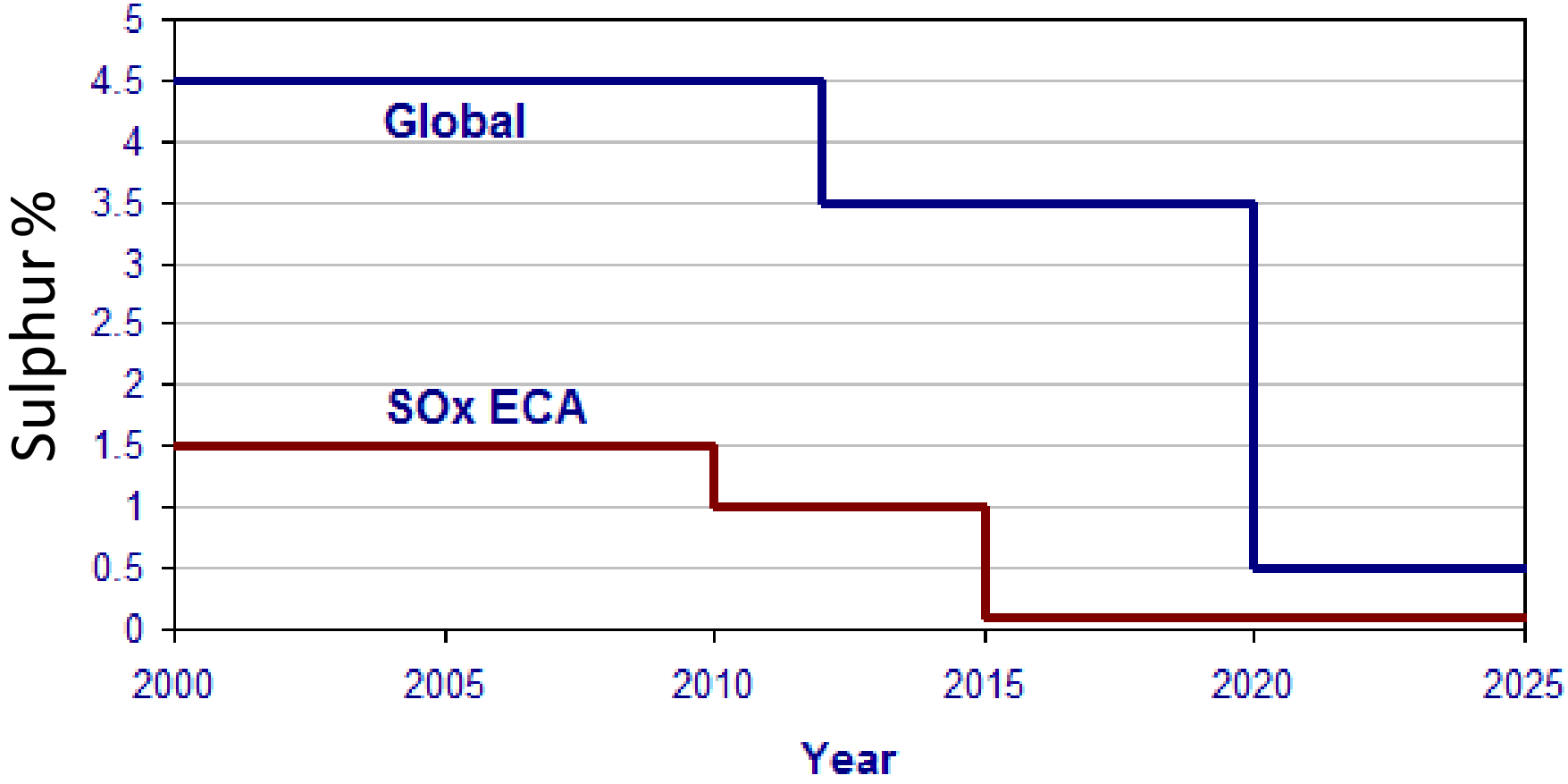

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What are the options for ship owners?

Using Gas Oil

- Easiest measure
- Lowest investment
- Increased cost

Exhaust Gas Scrubbers

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- Suitable option for large operators
- High investment
- Increased maintenance

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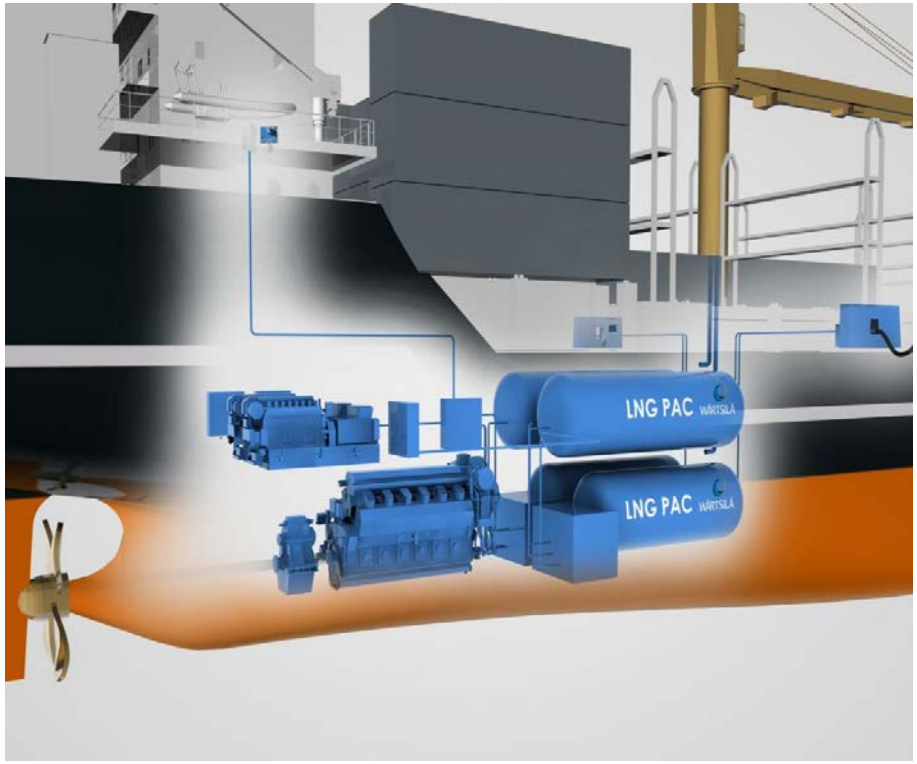
LNG as Fuel

- The cleanest option
- Meets the future NOx requirements
- Could be considerably cheaper



LNG as Fuel – The Facts

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- Stored as a liquid at minus 162 ° C
- Colour less and odour less
- 25% less CO^2 than fuel oil
- Widely used in land transport vehicles 14 million worldwide
- Relatively difficult to ignite
- No particulate emissions from the exhaust
- No problems with Cat Fines

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How will the legislation effect the Market?

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More engine damage claims?

More blackouts as a result of changing over fuels?

What claims will arise from scrubbers?

Risks associated with LNG as a fuel?

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That's another story.....

Thank you for listening

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THANK YOU - QUESTIONS?

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