



FOBAS FUEL INSIGHT

Fuel Quality report H2 2025

Looking back at the second half of 2025 and forward to the year ahead



Introduction

In our previous FOBAS (Fuel Oil Bunker Analysis & Advisory Service) Fuel Insight Fuel Quality Report, we examined the fuel quality landscape of the first half of 2025, highlighting the persistent and emerging challenges facing the marine fuel market.

This edition continues that analysis by focusing on the second half of 2025, a period shaped by the full enforcement of the Mediterranean Sulphur Emission Control Area and the industry's ongoing adaptation to evolving regulatory and commercial pressures. The themes identified earlier remain relevant, as operators contend with shifting fuel profiles, new compliance requirements, and the operational realities of a market in transition.

The latter half of the year was notable for a marked increase in off-specification events and a series of acute quality incidents, underscoring the need for continued vigilance and robust fuel management strategies.

H2 2025 at a glance

The second half of 2025 presented a challenging and dynamic fuel quality environment. While routine off-specification issues such as sulphur, water, and viscosity persisted in line with established patterns, the period was marked by a significant rise in the frequency and severity of regional quality failures.

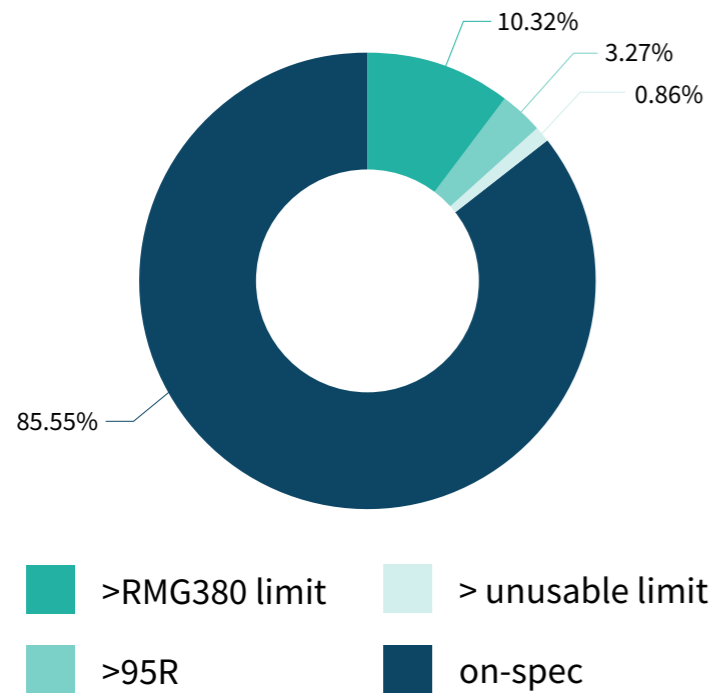
Notable among these were repeated incidents of high sulphur and catalytic fines in major bunkering hubs such as Singapore and Rotterdam, as well as elevated sediment and water content in ports including Antwerp and Hong Kong, which contributed to a demanding operational environment for vessels trading in these regions.

The closing months of the year saw a sharp escalation in off-specification cases, with December recording the highest monthly totals. These developments posed serious operational risks for vessels and highlighted the ongoing importance of supplier scrutiny, laboratory testing, and proactive onboard management.

Off-specification* fuels

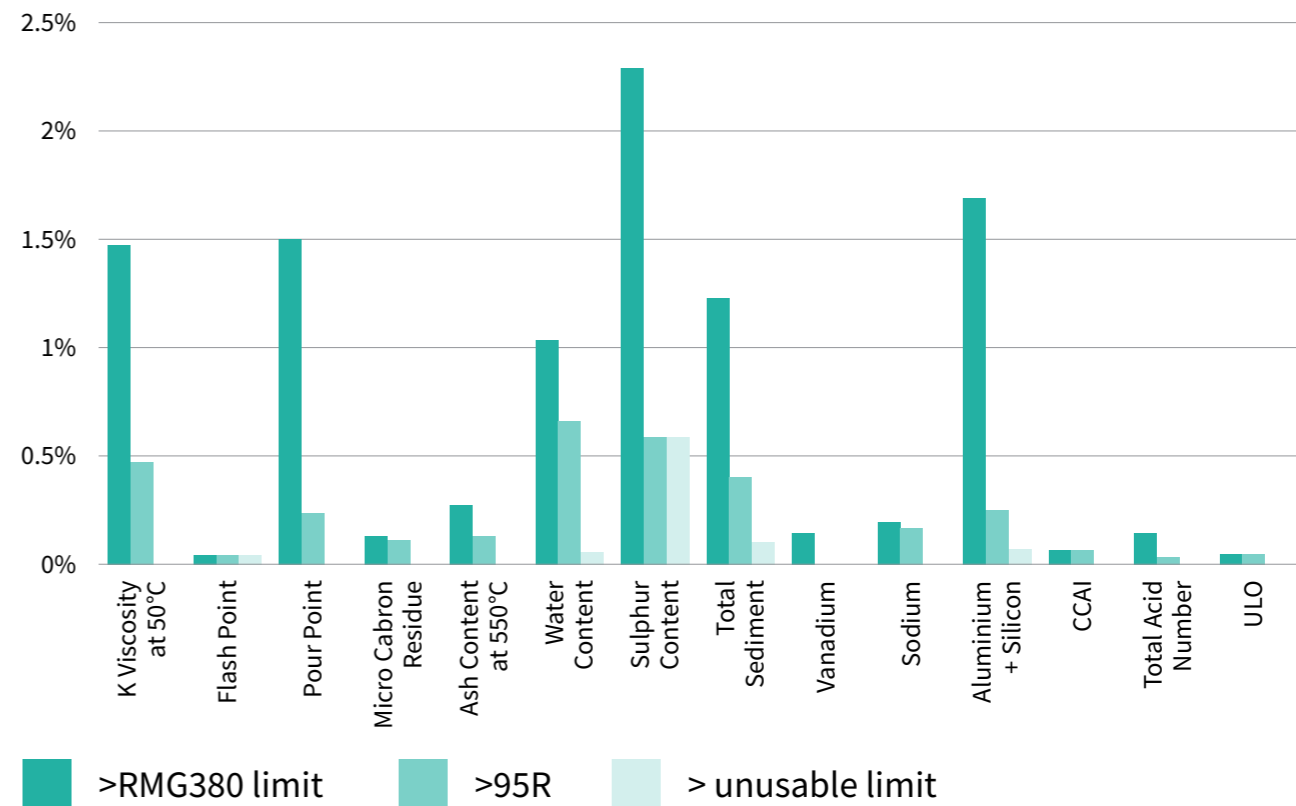
Residual based fuel oils

Figure 1: Residual off-spec



- Many off-spec fuels can still be used. 'Unusable' limit taken either from a regulation i.e. Sulphur/Flash Point, or levels where fuel management would become very difficult i.e. Water/sediments/cat-fines
- 95% confidence limit (R) or test tolerance range is applied as given in individual methods of the tested parameters using the principle outlined in ISO 4259

Figure 2: Residual off-spec (ISO 8217:2010 limits for RMG380 grade)



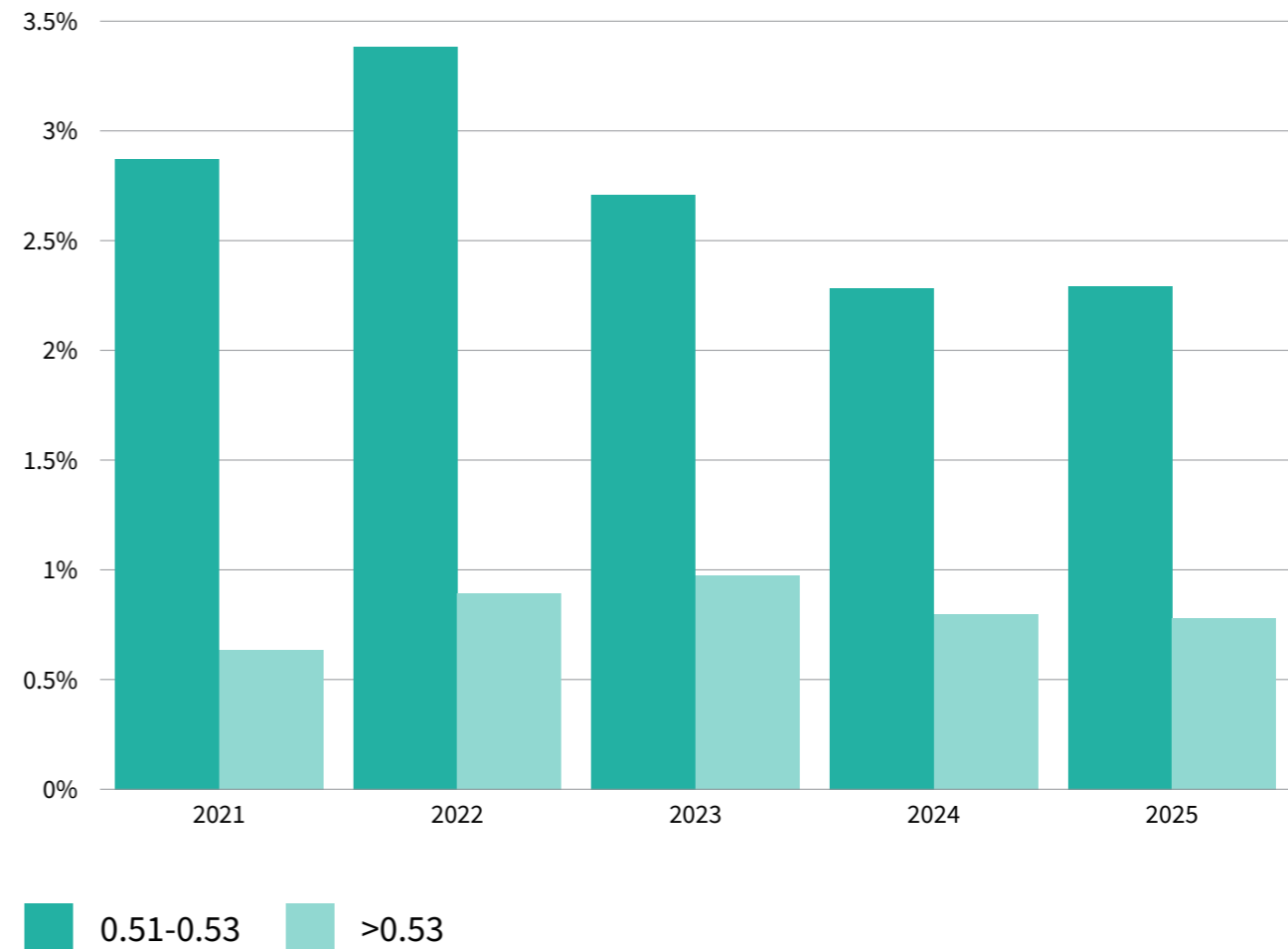
*Off specification being defined as when the fuel has exceeded the given ISO 8217 parameter limit + the 95% confidence 0.59R test precision allowance. So, for example 0.50% Sulphur limit is off spec when it has exceeded (0.50+0.03) 0.53%.

Around 15% of residual fuels reported in the second half of 2025 exceeded the specification limit as set by ISO 8217: 2010, noting a 2% increase from H1 2025 and with the overall picture otherwise resembling prior periods. What differentiates H2 is the late-year concentration of quality issues in several high-volume hubs. The principal parameters behind off-spec results remained broadly consistent—sulphur, stability (Total Sediment Potential), Aluminium + Silicon (cat fines) and water—but the period also featured a handful of very high outliers that raised immediate operational concerns.

Sulphur

The second half of 2025 saw more frequent high sulphur outliers in major bunkering locations. In November, a Rotterdam sample tested 1.85% m/m, and in December, Algeciras reached 1.69% m/m. There were also repeated exceedances reported around Hong Kong and Port Said. Elsewhere, St. Croix registered 2.41% m/m during December and Port Klang recorded multiple high results in August. These findings align with blend inconsistency or misclassification within the supply chains resulting in the supply of potentially non-compliant fuels. Unless the ship carries an Exhaust Gas Cleaning System (EGCS), there are not many other options except for de-bunkering.

Figure 3: Very Low Sulphur Fuel Oil (VLSFO) exceeding the 0.50% Sulphur limit



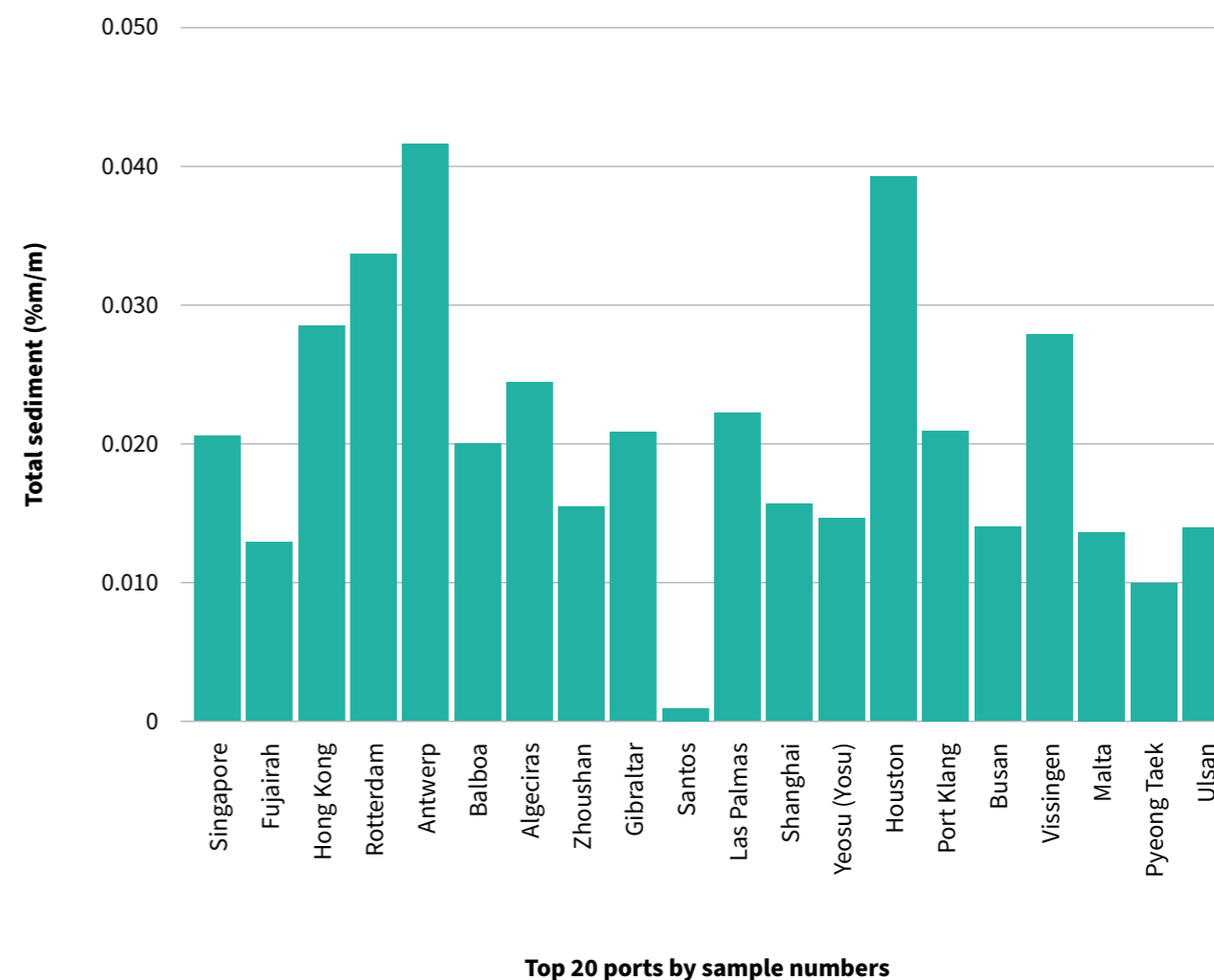
Total Sediment

Total Sediment continues to be one of the most significant challenges associated with residual fuels, with the **second** half of 2025 showing a persistence of this trend. Elevated Total Sediment results may arise from several factors, most linked to asphaltene instability within the fuel blend. The severity of this issue varies by port and region. The graph below illustrates the 20 highest-volume bunker ports by sample count, alongside the average reported Total Sediment results for each. Antwerp takes the lead in comparatively higher average values, with Houston following closely, although still, on average, comfortably within the ISO 8217 limit of 0.10 %m/m TSP, while Santos continues to present consistently very low results, with almost all samples reported at <0.01 %m/m.

It should be noted that in September, Amsterdam averaged 0.09% m/m, very close to the specification limit of 0.10% m/m. Antwerp showed multiple results between 0.18–0.37% m/m. Later that month Rotterdam recorded 0.39% m/m. In October, Cartagena produced an off-spec result of 1.11% m/m, while November and December included further extraordinarily high cases—Algeciras at 0.78% m/m and Ust Luga at 1.00% m/m. These values are consistent with asphaltene instability arising from incompatible blend components and are often accompanied by sludge formation, and rapid filter loading.

Figure 4: Average of Total Sediment

2025 1st July-31st December



Aluminium + Silicon (Cat-fines)

H2 2025 featured a broader and more severe spread of cat fine exceedances than earlier in the year. Singapore frequently returned 70–130 mg/kg results through August–November and produced extreme outliers in December (including 365 mg/kg and 580 mg/kg). Port Klang repeatedly appeared in the 76–97 mg/kg range; Hong Kong showed ~92–101 mg/kg; Gibraltar reported 83 mg/kg; and notable spikes included Ravenna (245 mg/kg, November) and Bonny (269 mg/kg, September). At such magnitudes, Al& Si reduction to levels acceptable for engine entry through on board treatment becomes unrealistic. Al& Si levels as distributed in fuel layers inside the tank need to be confirmed to make informed decisions on way forward.

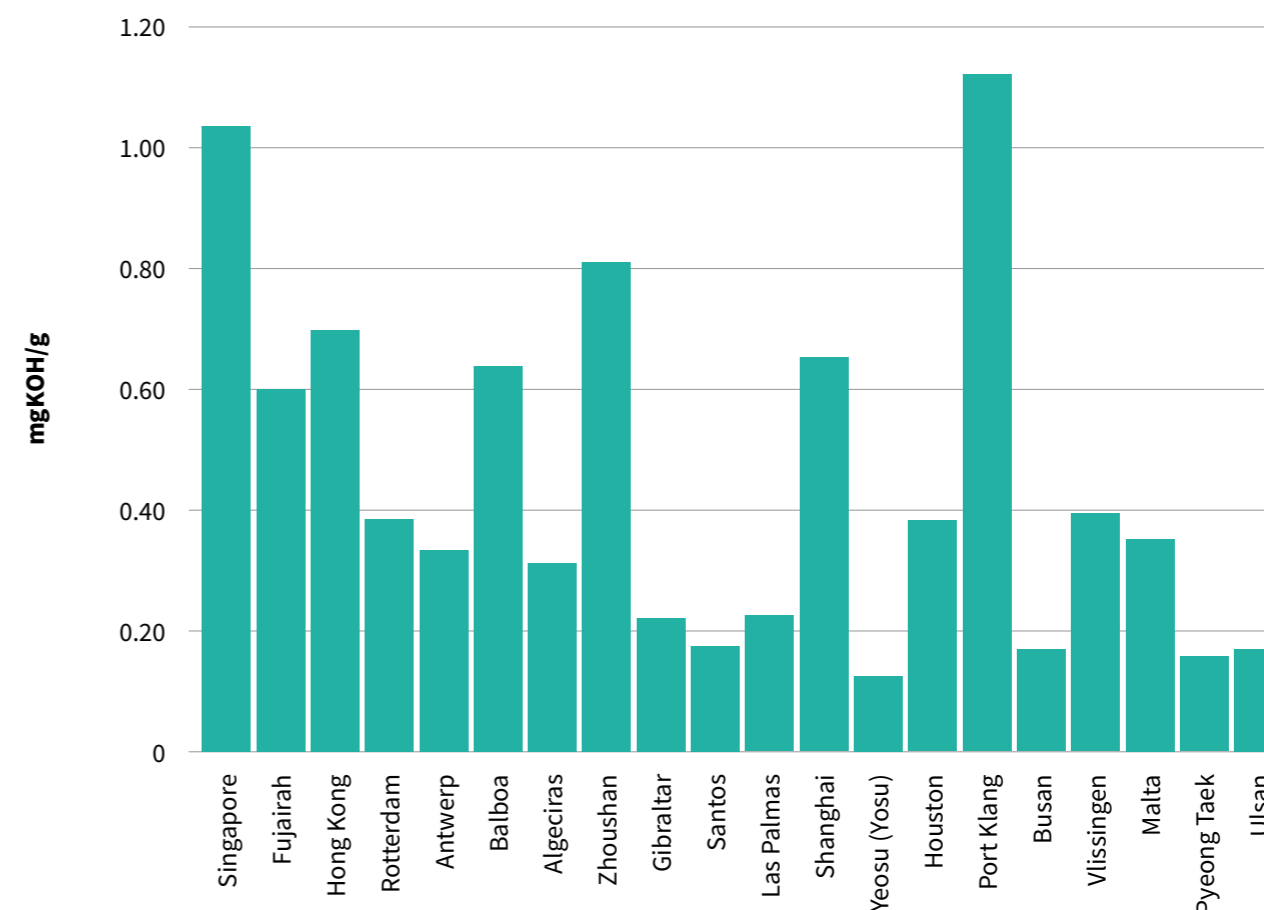
Acid Number

Off-spec acid number remained uncommon, but H2 included a series of higher results. The most pronounced was Novorossiysk at 5.90 mgKOH/g in August; in November, Itaquí recorded ~3.34 mgKOH/g and Fortaleza ~3.27–3.32 mgKOH/g typically naphthenic. In Singapore and parts of the Amsterdam-Rotterdam-Antwerp (ARA) region, values trended higher however within the allowable limit. In many cases this reflects naturally occurring naphthenic acids and is not, in isolation, operationally concerning. However, persistently high readings—particularly when coincident with metals or ash—indicates the need for continued and thorough monitoring.

Overall, H2 2025 resembled earlier periods in the types of parameters driving off-spec results, but differed in the concentration and severity of events across a handful of high-throughput ports toward year-end. The practical message for operators remains consistent: maintain tight margins to nominal limits, treat suspect fuels conservatively and elevate onboard fuel treatment discipline.

Figure 5: Average acid number of ports sampled

2025 1st July-31st December



Distillate fuel oils

Distillate fuels, particularly Marine Gas Oil (MGO), continued to demonstrate a generally higher degree of quality control and cleanliness compared to residual grades throughout the second half of 2025. Nevertheless, several parameters remain critical for compliance and operational reliability, most notably flash point and sulphur content, as well as cold flow properties and the increasing prevalence of biofuel blending. While it is uncommon for a distillate fuel to be of such poor quality as to require de-bunkering, off-specification results for sulphur and flash point can render a fuel non-compliant with IMO or local regulations and, in some cases, unsuitable for use.

Figure 6: Marine Gas Oil (MGO) Distillate Marine Fuel Grade A (DMA) off-spec H1 2025

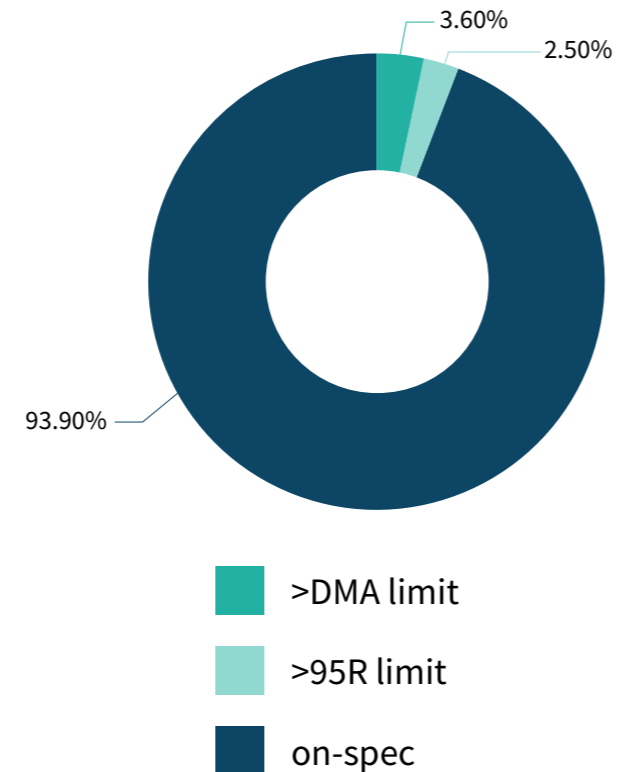
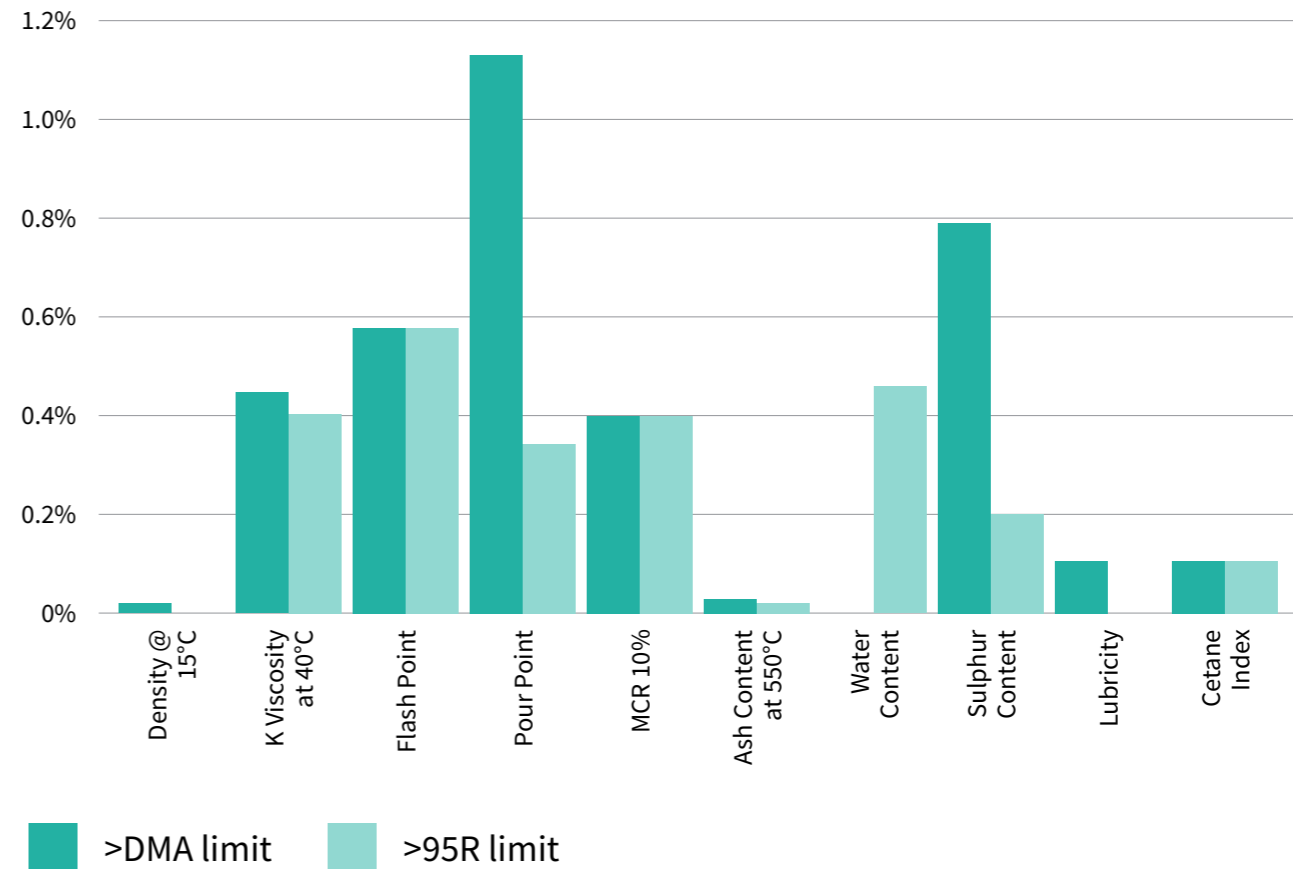


Figure 7: Distillate off-spec (ISO 8217:2017 DMA limits) H2 2025



Viscosity in distillate fuels was occasionally found to be marginally above the 6 cSt limit, but these cases were typically minor and did not present significant operational challenges. More frequently, attention was drawn to cold flow properties, particularly pour point, cloud point, and Cold Filter Plugging Point (CFPP). During H2 2025, pour point values in the 0–6°C range were observed in several ports. Notably, ports such as Rotterdam and Antwerp continued to supply distillate fuels with elevated CFPP values, a trend that becomes especially relevant as winter approaches in the northern hemisphere. The risk of wax precipitation and filter plugging increases as temperatures drop, making it essential for operators to understand both the CFPP of the fuel. The absence of specified limits for cloud point and CFPP in ISO 8217 places the onus on suppliers to provide these values upon request and on operators to assess the suitability of the fuel for their intended trading pattern.

Figure 8: Cold filter plugging point (CFPP) 5-9 °C

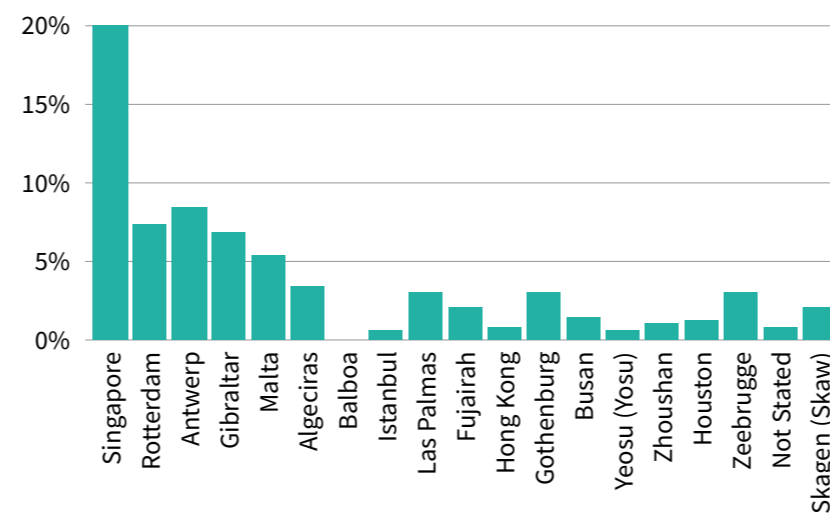


Figure 9: Cold filter plugging point (CFPP) 10-14 °C

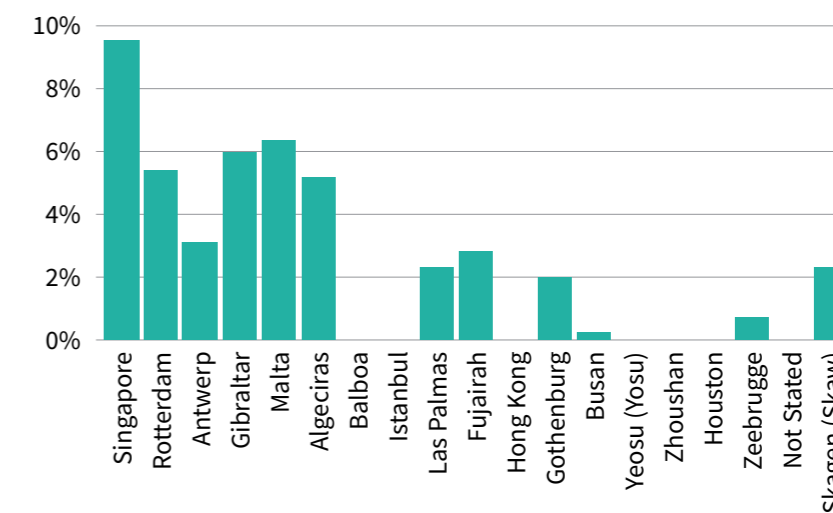


Figure 10: Cold filter plugging point (CFPP) 15-19 °C

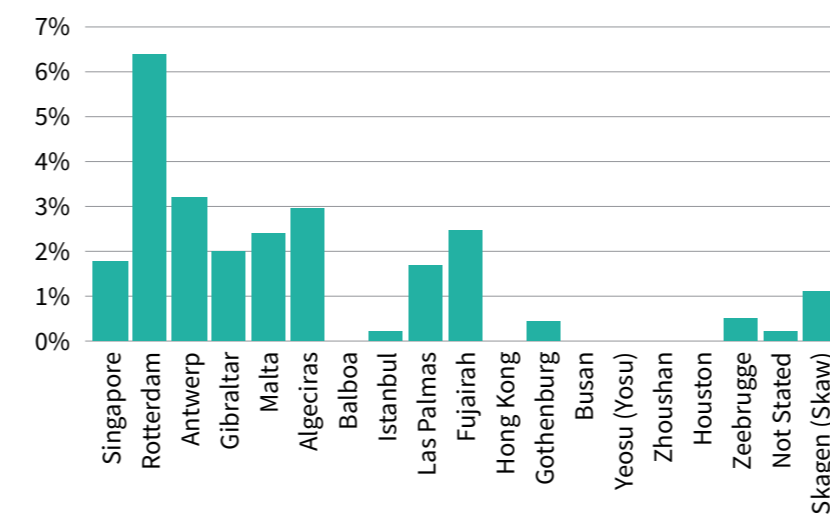
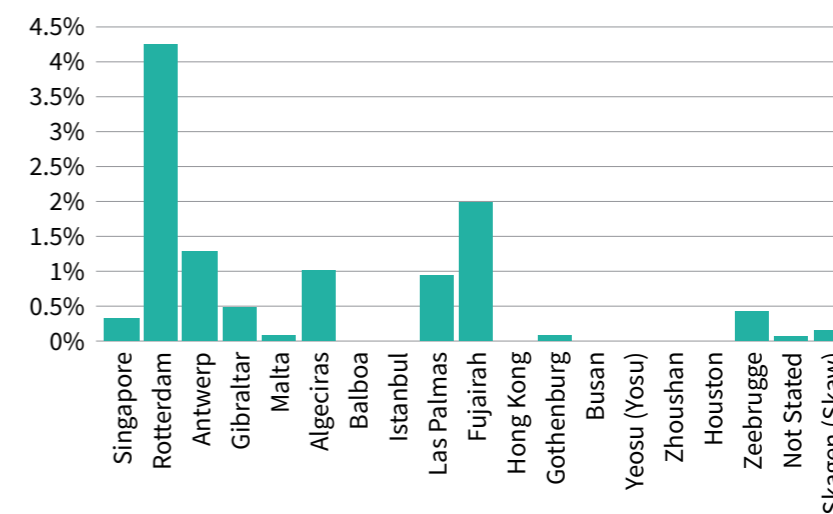


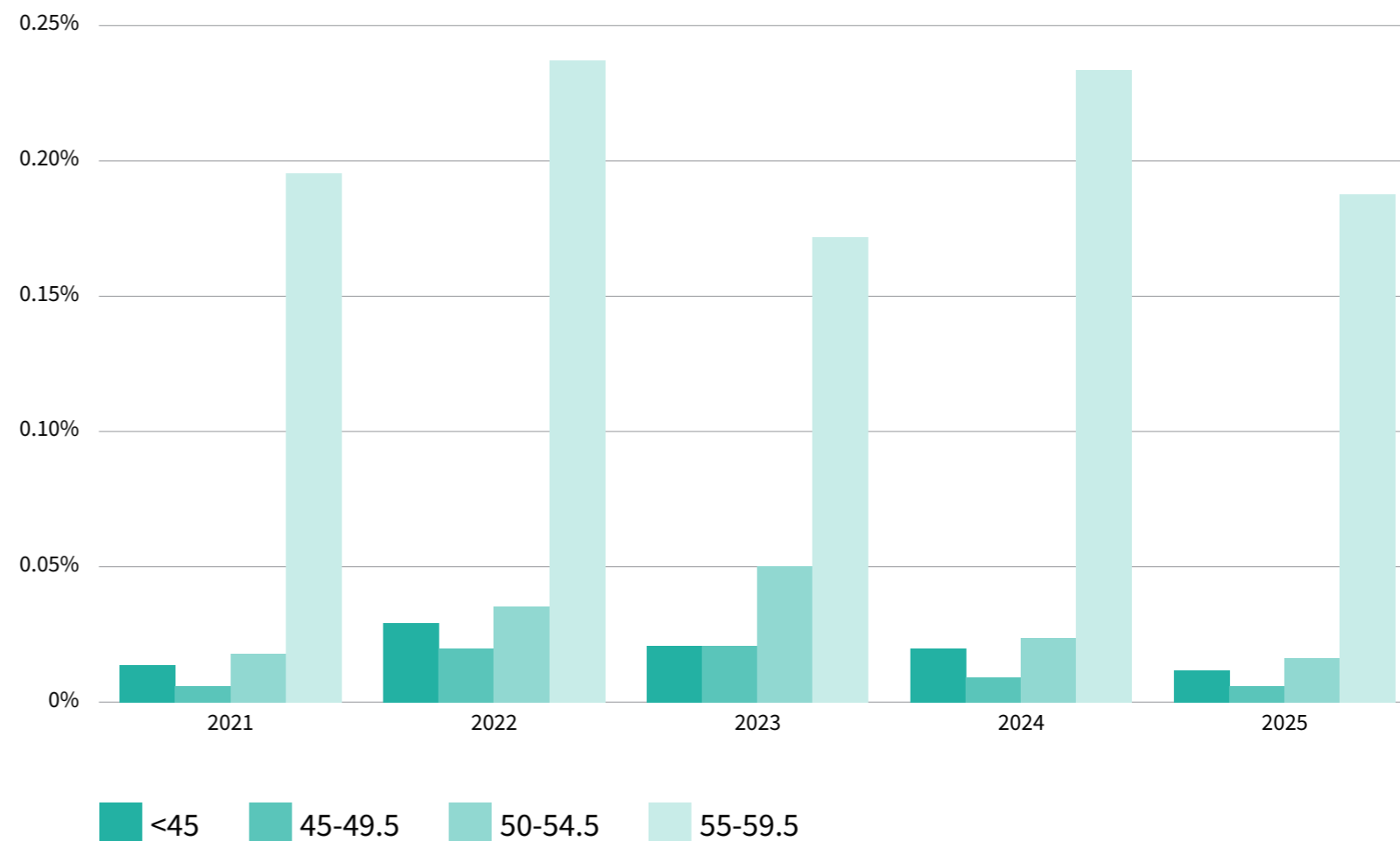
Figure 11: Cold filter plugging point (CFPP) 20+ °C



Flash point non-compliance remained a recurring issue in the distillate pool. While the majority of low flash point cases were marginal, H2 2025 saw several severe breaches of the SOLAS minimum of 60°C. Samples tested in Civitavecchia, Lisbon, and Palermo, among others, returned flash points well below the regulatory threshold, with some results in the range of 47–55°C. Such findings represent a significant safety risk and a clear breach of international regulations. In certain instances, particularly in smaller ports or where yachts and non-convention vessels are supplied, the fuel offered may be a land-grade diesel not blended to meet marine requirements. This underscores the importance of supplier diligence and laboratory verification, especially when bunkering outside major hubs.

Sulphur content in distillate fuels continued to attract scrutiny, with most off-specification cases falling just above the 0.10% or 0.50% m/m limits, depending on the regulatory area. H2 2025 data showed that while many distillate fuels remained compliant, there were notable exceptions in ports such as Hong Kong, Antwerp, and Port Said, where samples exceeded the prescribed limits. These cases, though relatively infrequent, highlight the ongoing need for robust supplier quality assurance and regular onboard testing to ensure compliance with MARPOL Annex VI and local requirements.

Figure 12: Marine Gas Oil (MGO) Flash point



Investigative testing and major incidents

Alongside routine conformity testing, the second half of 2025 saw a steady flow of investigative chemical analyses prompted by atypical behaviour in service—elevated acid numbers, persistent instability (TSP), fine filter plugging, and abrasive wear indications. Method selection remained case-specific, ranging from extended hydrocarbon profiling and targeted scans for problematic species to metals screening and solvent stability checks. It is important to interpret these findings in the context of the specific parcels involved: forensic results can explain a ship's experience with a particular supply without necessarily generalising to an entire port or region.

Most high acid number fuels continued to be linked to naphthenic acids naturally present in crude sources and, on their own, were not operationally problematic within ISO 8217 limits. In H2 2025, however, there were pockets of higher values—Novorossiysk reached ~5.90 mgKOH/g in August, and Itaquí and Fortaleza recorded ~3.3 mgKOH/g in November—that coincided with other stressors (instability, ash, metals). Where such combinations occurred, ships reported heavier sludge through purification and more frequent filter maintenance, reinforcing the need to minimise long-term storage of marginally stable blends.



Major incidents and clusters (H2 2025)

CASE 1: MULTI-PARAMETER STRESS IN SINGAPORE (LATE Q3–Q4)

From August through December, Singapore exhibited an unusual concentration of high cat fines, elevated ash and sodium, water outliers, and occasional marginal flash point readings. Aluminium + silicon was frequently in the 70–130 mg/kg band and rose to ~365 mg/kg and ~580 mg/kg in December outliers. Sodium climbed to ~636 mg/kg, ash reached ~0.35% m/m, and water in some parcels exceeded 5% vol; earlier in the year Singapore had also returned low flash point in isolated cases (e.g., 33°C). Although many liftings remained compliant and performed normally, this cluster formed a clear treatment-intensive risk profile.

CASE 2: ARA STABILITY AND CLEANLINESS ISSUES (SEPTEMBER–OCTOBER)

Across the Amsterdam–Rotterdam–Antwerp (ARA) hub, the period featured sustained TSP elevation and intermittent cleanliness concerns. In September, Amsterdam averaged ~0.26% m/m, Antwerp produced multiple results between ~0.18–0.37% m/m, and Rotterdam reached ~0.39% m/m; earlier in the season Antwerp also recorded water up to ~1.35% vol and sodium near ~980 mg/kg. While many values were near to, rather than far above, limits, the consistency of findings across successive bulletins pointed to blend stability pressures in the regional supply chain. Ships bunkering higher sediment parcels reported increased purifier attention and filter maintenance. Investigative checks generally confirmed asphaltene instability as the proximate cause rather than unusual contaminants, emphasising the benefit of shorter residence times, avoiding commingling, and tightened purifier settings until stability margins improve.

CASE 3: SEVERE LOW FLASH POINT EPISODES IN THE MEDITERRANEAN AND ADJACENT TRADES

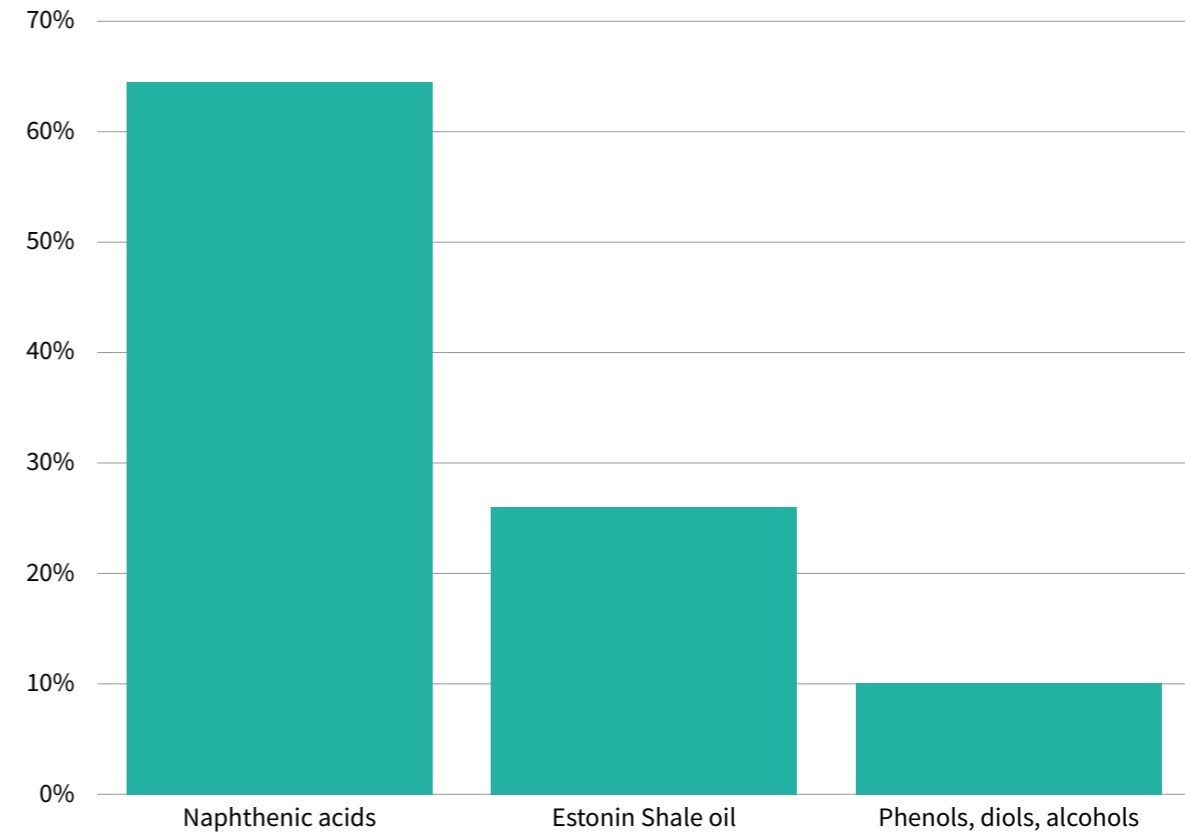
H2 2025 included repeated distillate flash point failures in Civitavecchia, Lisbon, Palermo, and Lianyungang, with several results clearly below the 60°C SOLAS minimum (e.g., 47–55°C ranges), and isolated residual cases with very low flash points in other ports (e.g., Tarragona near ~24°C). These are statutory breaches that demand immediate segregation, supplier escalation, and verification before any use. In several investigations, affected fuels were otherwise close to specification in routine parameters, underscoring that partial compliance does not override the standard's general requirements prohibiting materials at concentrations that jeopardise safety or machinery performance. In smaller markets—yacht and non-convention craft—there was evidence of land-grade diesel entering the marine pool, explicit grade confirmation and laboratory flash point verification are essential safeguards for those trades.

CASE 4: VERY HIGH WATER AND SODIUM – ARA AND BEYOND.

The period also featured exceptional water and sodium outliers with direct operational impact. In late July and early August, Rotterdam recorded ~11.05% vol and ~14.6% vol water in separate parcels—the highest levels noted in H2. Elevated sodium accompanied the wider cleanliness picture: Antwerp and Rotterdam returned ~980 mg/kg and ~945 mg/kg respectively earlier in the season, while Singapore reached ~636 mg/kg in December. Ships receiving these parcels reported increased separator carry-over, faster filter loading, and, in some cases, post-combustion deposit build-up consistent with high ash/sodium fuels. Recommended responses included immediate segregation, intensified tank bottom draining, down-rating purifier throughput, and scheduling intermediate filter changes during passage, with follow-up laboratory checks guiding any commingling or use decisions.

While there have been no widespread contamination incidents like we saw in Istanbul in early 2025, we do still see from time to time chemical contamination in some fuels, often in major bunkering hubs, Houston, Rotterdam and Singapore. Contamination often is a mix of various alcohols, phenols and other chemicals related to various industrial processes but not intended to be a fuel. It is often difficult to argue a case against the fuel quality based on analysis result alone due to the lack of any clear definition in the ISO8217 fuel standard, however with fully documented evidence including onboard handling, operational performance of the fuel and clear test results the worst fuels can be avoided or removed.

Figure 13: Gas Chromatography-Mass Spectrometry (GCMS) analysis on high acid number or problem fuels



Biofuels – FAME

Biofuel usage onboard ships increased further in H2 2025, with more operators routinely bunkering or trialling Fatty Acid Methyl Esters (FAME)-based blends. The main bio-derived products remain FAME, standardised in EN 14214 and ASTM D6751, and hydrotreated vegetable oil (HVO). ISO 8217:2024 now formally covers these fuels, with Table 3 specifying residual blends containing FAME and Table 1 permitting up to 100% FAME in distillate grades.

The most common blend observed is VLSFO/FAME at approximately 30% FAME (“B30”). This ratio is preferred for maintaining conventional fuel properties and is often dictated by local supply regulations. Singapore remains in a prominent position for VLSFO/FAME bunkering, with increased activity also noted in Algeciras and the ARA region. No operational issues directly attributable to FAME were reported in H2 2025. Where problems occurred—high sulphur, cat-fines, sediment—these were linked to the VLSFO fraction.

Figure 14: Percentage of samples

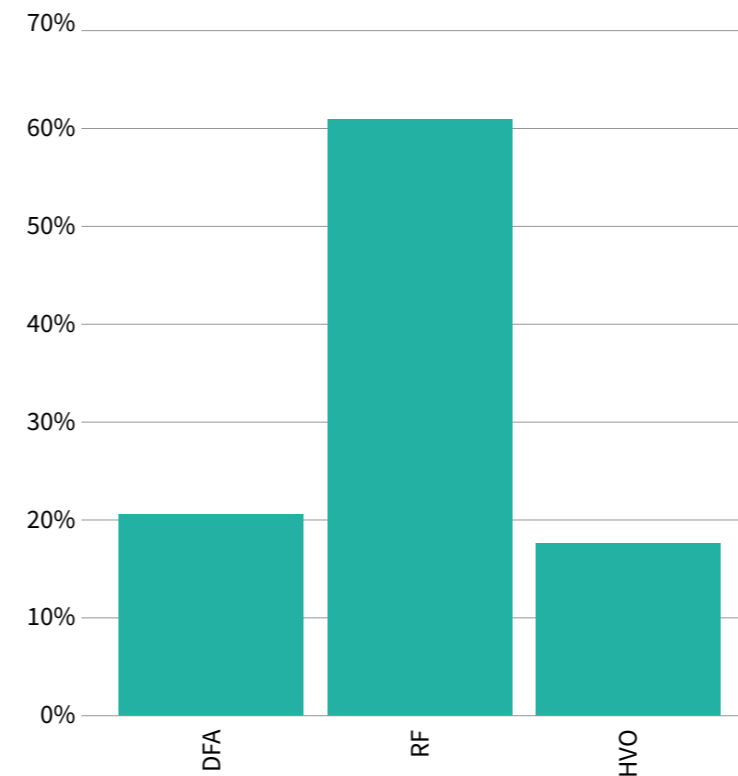
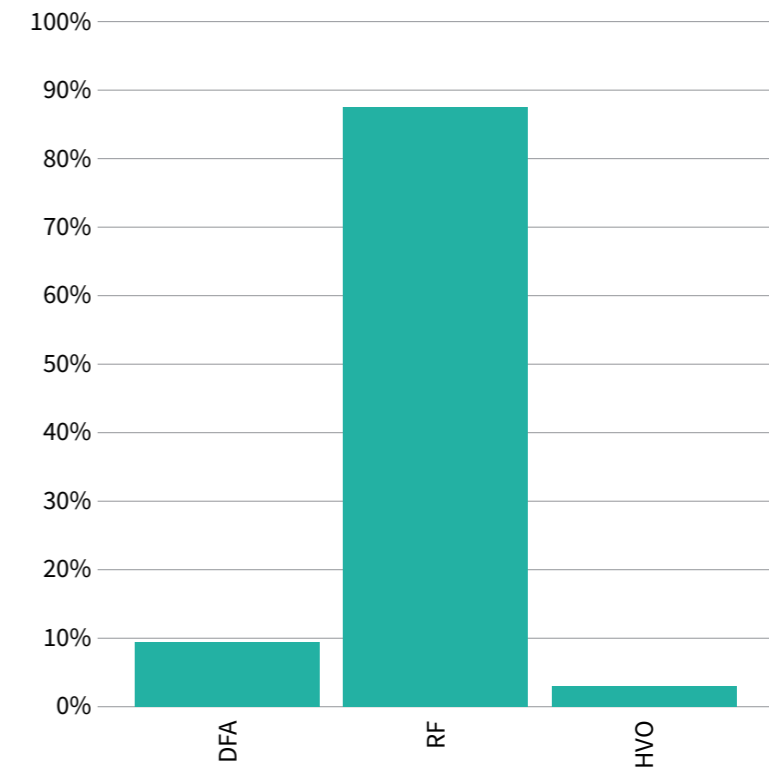


Figure 15 : Percentage by quantity



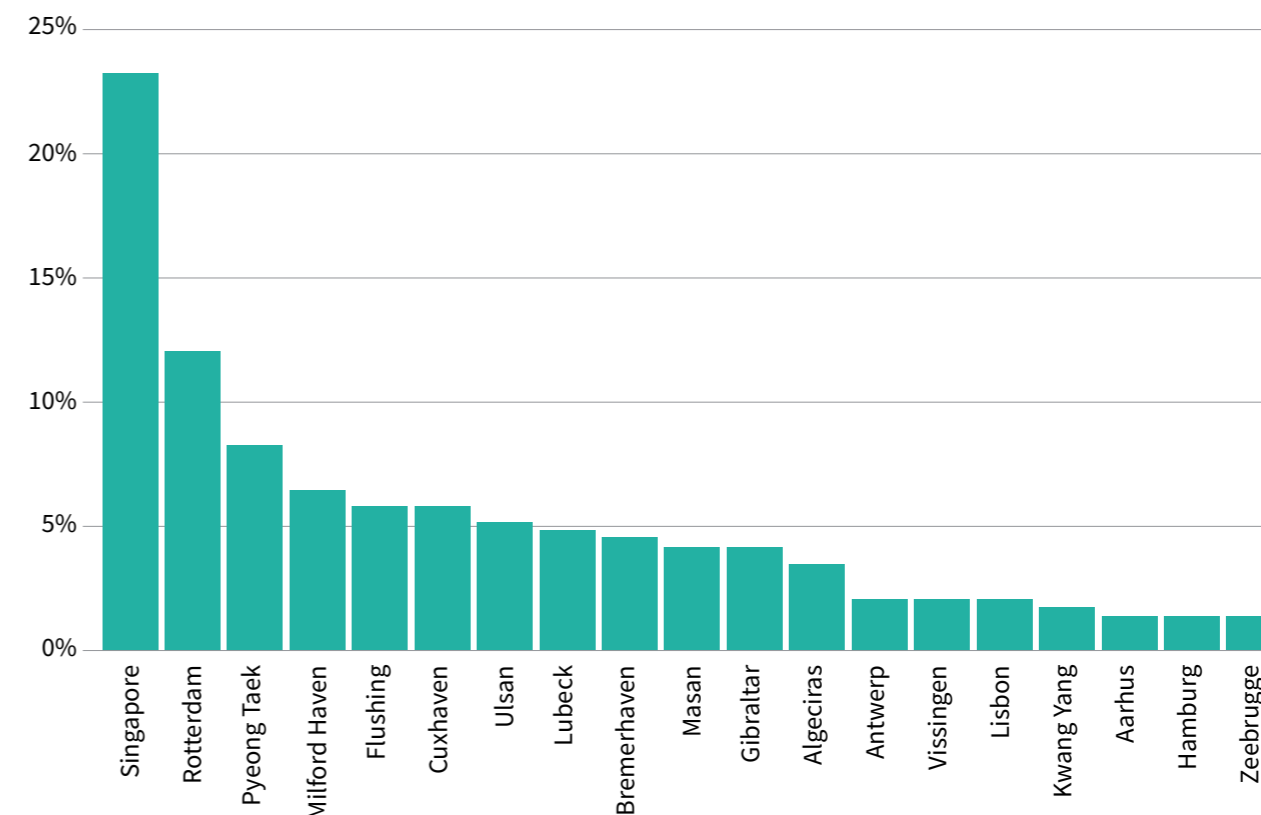
Cold flow properties (pour point, CFPP) and blend variability remain key considerations. Operators are advised to request full disclosure of blend ratios and monitor storage and handling, especially in colder climates.

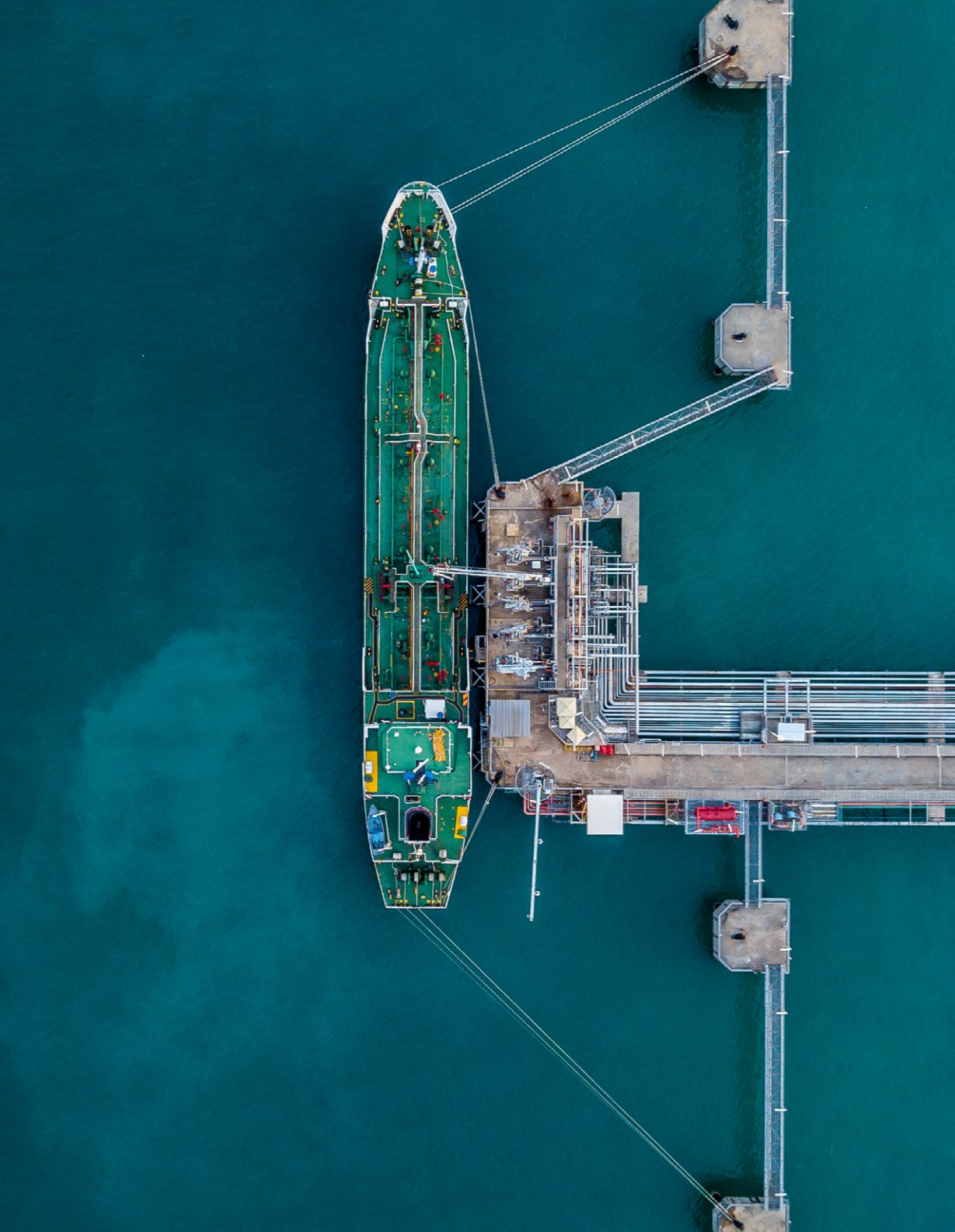
Regulatory changes continue to drive adoption. The Mediterranean Sulphur Emission Control Area and EU/IMO requirements incentivise biofuel uptake. The latest ISO 8217 revision provides clarity, but operators must ensure that supplied fuels meet both specification and operational needs.

Biofuel integration increased in H2 2025, with B30 blends being widely used and no significant FAME-related incidents reported. The majority of off-spec cases in blended fuels were associated with the conventional VLSFO component. Continued diligence in specification, supply chain management, and onboard handling is recommended.

Along with the usual off-spec fuels and operational challenges we notice an ongoing issue where there is often a considerable difference between results from fuel samples taken at the vessel manifold, during bunkering, to the samples later tested as part of a joint analysis with fuel suppliers. It is not uncommon to see a fuel that has an off-spec result from the vessel manifold subsequently show a much lower on-spec result in joint sampling analysis. The reasons behind this could vary but it highlights the importance of ensuring correct sampling procedures are followed and that any ship operator is clear about how all samples have been taken, including any suppliers' samples. In many cases it may also be advisable to take further tank samples to get a clearer picture of the true fuel quality on board, especially if ship operator and supplier samples show considerably different results.

Figure 16: Percentage biofuels sample tested H2 2025





Methanol as a marine fuel

The maritime industry is undergoing a major transition driven by environmental regulations, decarbonisation targets, and growing pressure to reduce greenhouse gas (GHG) emissions. Among the alternative fuels being considered, methanol has been one of the most practical and near-term solutions for shipping. One of methanol's strongest advantages is its existing global infrastructure. Methanol is already traded worldwide as a chemical commodity, and bunkering can often be adapted from conventional liquid fuel systems. Also, it is liquid state at ambient conditions. Major shipowners, charterers, and fuel suppliers have committed to methanol as a key alternative fuel. Large container vessels, tankers, and ro-ro ships are already being ordered or delivered with methanol propulsion. With increasing production of green methanol and supportive regulation, methanol is expected to play a central role in the maritime energy transition. Methanol (CH_3OH) is a simple alcohol that can be produced from various feedstocks:

- Fossil-based methanol (from natural gas or coal)
- Bio-methanol (from biomass or waste)
- E-methanol (from renewable hydrogen and captured CO_2)

From a decarbonisation perspective, bio- and e-methanol are particularly important, as they can significantly reduce lifecycle GHG emissions compared to conventional marine fuels. FOBAS labs are equipped to analyse Methanol samples. Methanol will be tested as per the ISO 6583 : 2024 standard. Singapore standard TR 129, can also be used as guidance. Please refer to LR [Fuel for thought – Methanol](#), for more information.

Year ahead

The outlook for marine fuel quality and compliance in 2026 is shaped by a convergence of regulatory, operational, and technical factors. The full implementation of the Mediterranean Sulphur Emission Control Area has already altered sourcing patterns and increased scrutiny on sulphur compliance, with several off-spec incidents in H2 2025 underscoring the need for ongoing vigilance. As more regions adopt or tighten emissions controls, operators should expect further shifts in fuel availability and specification, particularly at major transshipment and bunkering hubs.

The expansion of the EU Emissions Trading System and the introduction of FuelEU Maritime requirements are expected to accelerate the transition towards lower-carbon fuels and more stringent carbon intensity management. This regulatory pressure, combined with the updated ISO 8217 standard, is likely to drive further uptake of biofuel blends and alternative feedstocks. However, the H2 2025 data highlight persistent variability in fuel quality, especially as new blends enter the market. Operators will need to maintain robust supplier vetting, laboratory testing, and onboard management practices to mitigate risks associated with blend inconsistency, contamination, and off-spec parameters.

Technical challenges are also set to increase as the fuel mix diversifies. The growing use of FAME and other bio-derived components requires careful attention

to energy measurement, storage stability, and compatibility with existing systems. The emergence of alternative fuels such as methanol, ammonia, and hydrogen introduces new operational and safety considerations, from crew training to fuel handling infrastructure. While these fuels are not yet mainstream, pilot projects and early adoption are likely to expand, and technical managers should monitor developments closely.

In this evolving environment, proactive fuel management, continuous monitoring of regulatory changes, and investment in crew training are also going to become increasingly important going forward. The lessons of H2 2025—particularly the clustering of off-spec events in key ports and the operational impact of blend variability—reinforce the importance of adaptability and technical discipline as the industry moves into a more complex and regulated fuel landscape.



To find out more about Alternative fuels for shipping, please refer to LR's industry leading research report series – [Fuel for thought](#)



Summary

The second half of 2025 was marked by a notable escalation in both the frequency and severity of fuel quality challenges across the global marine sector. While longstanding concerns such as cat-fines, stability, sulphur, water, and flash point non-compliance persisted, H2 was distinguished by a series of acute incidents concentrated in major bunkering hubs. High sulphur outliers in Singapore, Rotterdam, and Algeciras, repeated cat-fine exceedances, and exceptional water and sediment levels in ports such as Antwerp, Hong Kong, and Rotterdam all contributed to a complex operational environment.

Clusters of off-specification events, particularly towards the end of the year, highlighted ongoing vulnerabilities in the supply chain, especially as new blends and alternative feedstocks entered the market. The data from H2 2025 reinforced the importance of robust supplier vetting, laboratory testing, and proactive onboard management, as even routine parameters could quickly become

operational risks when limits were exceeded by significant margins.

At the same time, regulatory developments—including the full enforcement of the Mediterranean Sulphur Emission Control Area, the expansion of EU ETS, and the adoption of the latest ISO 8217 standard—continued to reshape fuel sourcing and compliance strategies. The growing use of biofuels and the emergence of alternative fuels present both opportunities and new technical challenges, particularly in the areas of energy measurement and blend consistency.

As the industry moves into 2026, the lessons of H2 2025 underscore the need for adaptability, technical discipline, and close monitoring of both regulatory and supply chain developments. FOBAS will continue to provide guidance and support as operators navigate this evolving landscape, helping to ensure safe, compliant, and efficient fuel management in the months ahead.



For more information visit www.lr.org/FOBAS



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