

Simple Sulfur in Bunker Fuel Compliance

BACKGROUND

The International Maritime Organization's (IMO) Marine Environment Protection Committee (MEPC 70) will lower the maximum allowable sulfur content from 3.50% to 0.50%, which will go into effect on January 1, 2020. In order to comply with the new regulation, ship owners and operators will need to decide between two main options:

1. continue to burn High Sulfur Fuel Oil (HSFO) and retrofit their ships with exhaust gas scrubbers that remove the SO_x
2. switch from HSFO to Low Sulfur Fuel Oil (LSFO)

A recent survey was conducted and the results show that two-thirds of cargo ship owners expect to switch to LSFO and only 13% plan to retrofit ships with emissions scrubbers*. IMO regulations will continue to require compliance with the 0.10% maximum sulfur limits when operating in Emission Control Areas (ECAs).

CHALLENGE

With the price differential between HSFO and LSFO being hundreds of dollars per ton, scrubbers present an option for continued use of the much less expensive HSFO. However, the industry has identified several drawbacks to retrofitting vessels. Estimates for installation of scrubbers can range up to \$10 million. In addition to the large capital expense requirements, part of the price differential in fuel cost will be spent on scrubber operational costs, required chemicals, sludge disposal, repair, maintenance, and other costs projected at \$45/ton of bunker fuel scrubbed. The scrubber systems are quite complex. One shipping industry executive described them as "like installing small refineries." Because there is little financial incentive to invest in emission scrubber systems prior to the regulation implementation, expert forecasts foresee as few as 2000 ships being retrofitted prior to 2020. The majority of those ships that are retrofitted are expected to be in a rush after the low sulfur fuel is required. Capacity for these retrofits is expected to be constrained to around 3000 retrofits per year. Ship owners are investigating whether the higher fuel prices will materially affect them, or if the costs will become the problem of the ship charterer as they are so often responsible for fueling the ship.

Enforcement of the regulation is still under discussion and investigation which adds to the uncertainty in making a decision about which option to choose. In April 2018, a draft amendment to the regulation would ban ships from carrying fuel that exceeded the 0.5% sulfur limit in order to demonstrate compliance. Yet to be concluded is how ships that choose to use emissions scrubbers will be required to demonstrate that they are properly operating their scrubbers to eliminate emissions while at sea.

Ship owners and charterers are not the only ones that will be impacted by the change in sulfur regulation for marine fuel oil. Refiners will see the demand balance for their refined products shift dramatically as HSFO will no longer be a viable option for many ships. While there may be a period of higher margins for some of the low sulfur blending components that will be used to provide the LSFO needed by the shipping industry, disposing of the excess high sulfur residue that is used as HSFO today will be a challenge. These streams are difficult to process and require additional conversion capacity that are capital and energy intensive. Bringing on additional conversion capacity takes years and will not be ready in time for 2020. As such, supply of LSFO is expected to be constrained. With large price differentials between HSFO and LSFO, the incentive to provide fuel over the 0.5% sulfur specification will be large. Ship owners and charterers alike need a way to ensure that the fuel they are purchasing meets the regulation.

In addition to concerns about complying with the new LSFO regulations in 2020, ship owners and operators must continue to switch over to 0.10% sulfur fuel when entering ECAs. This switchover requires a careful plan that affects fuel temperature and viscosity, lubricant type, and can introduce fuel compatibility issues. The process must be started many hours prior to entering an ECA and without a sulfur measurement technique, it is not possible to know if the switchover has been successfully completed.

SOLUTION

The test methods and specifications approved for marine fuel are controlled by ISO 8217. Sulfur measurement methods compliant with the specification include ISO 8754, ASTM D4294, and IP 336. These methods all use a technology called X-ray Fluorescence (XRF) that is widely used by refiners and fuel laboratories around the world for sulfur analysis. While it can seem intimidating to use laboratory equipment for those that don't use it routinely, XRF technology has been selected by non-technical users for field applications like port customs inspection and environmental hazard investigation because it is simple to use and provides results in just minutes.

Petra MAX, a multi-elemental analyzer by XOS, is an ideal solution for shipboard analysis of sulfur in marine fuel to ensure compliance with existing ECA sulfur requirements and 2020 regulations. The analyzer is compact, robust, and easy for non-technical operators to use. Analysis is as simple as pouring a few mL of fuel into a disposable plastic cup, sealing with a plastic film, closing the lid on the analyzer and pressing "Measure". The instrument complies with the same ISO 8217 approved methods that are used by fuel laboratories and refineries.



Petra MAX™ delivers advanced D4294 sulfur analysis in addition to 12 elements from P to Zn including Ni, V, and Fe. This robust benchtop analyzer complies with ASTM D4294 and ISO 8754 for measuring sulfur in hydrocarbons. Petra MAX is powered by HDXRF, utilizing XOS patented doubly curved crystal optics coupled with a high-performance silicon drift detector and an intense monochromatic excitation beam. This industry-leading technology reduces background noise and increases signal-to-noise output, enabling low detection limits and high precision without the need for consumable helium gas, a vacuum pump, or extensive sample preparation.

APPLICATION STUDY

To demonstrate the simplicity of achieving lab quality results with Petra, an application study was conducted. Three fuel oil samples with a sulfur concentration similar to expected levels in various types of marine fuel samples was used in the study. The sulfur concentration was certified by an independent laboratory for each fuel oil. The concentrations can be seen in **Table 1**.

Sulfur Concentration wt.%	Corresponding Marine Fuel
0.10%	ECA Fuel
0.50%	2020 IMO LSFO
3.00%	HSFO

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Each fuel oil was prepared and analyzed 10 times each to evaluate the accuracy and consistency of marine fuel sample analysis. To prepare each sample, 7 mL of fuel was poured or pipetted into a small disposable sample cup, a plastic film was placed over the top, and a ring was snapped over the top to seal the fuel inside. The sealed cup was placed in the instrument and the lid closed. The measurement was initiated by pressing a button on the instrument touch screen. The sample was analyzed for 100 seconds and the results displayed on the screen, and then stored in the onboard memory for later viewing. Data can be exported via USB or Ethernet connection. Standard desktop PC printers can also be used to print results. Results of the analysis are reported in **Table 2**.

Table 2: Petra Study Results (Reported in %)			
Repeat	ECA Fuel	2020 IMO LSFO	HSFO
1	0.10	0.50	2.99
2	0.10	0.50	3.00
3	0.10	0.49	3.00
4	0.10	0.49	3.02
5	0.10	0.49	3.00
6	0.10	0.49	3.01
7	0.10	0.49	3.01
8	0.10	0.48	3.00
9	0.10	0.48	3.01
10	0.10	0.49	3.01
Average	0.10	0.49	3.01
Standard Deviation	0.001	0.007	0.006
RSD%	0.8%	1.5%	0.2%

Study conducted using Petra 4294 analyzer.

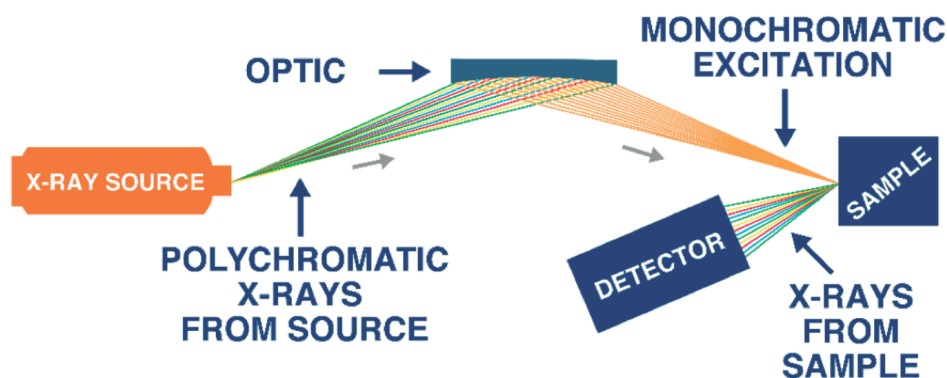
CONCLUSION

With so much uncertainty about the impact to ship owners and charterers on the upcoming 2020 sulfur regulation, Petra MAX offers a fast, simple way to ensure that fuel meets the regulation and that you get what you pay for. Using the same standard methods approved in ISO 8217, non-laboratory staff can rapidly confirm sulfur levels.

ADVANCED ANALYSIS WITH HDXRF

Figure 1 shows the basic configuration of HDXRF and its use of focused monochromatic excitation. In this system, the diffraction-based doubly curved crystal optics capture a wide angle of X-rays from the source and focus a narrow energy band (monochromatic) of X-rays to a small spot on a measurement cell. The monochromatic beam excites the sample and secondary characteristic fluorescence X-rays are emitted. A detector processes the secondary X-rays and the instrument reports elemental composition of the sample.

Figure 1: HDXRF Technology



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