In October 2016, the International Maritime Organization, an agency of the United Nations, agreed to implement new regulations that reduce sulfur emissions from vessels. This is the culmination of an effort that began in 2005, which has long had a small impact on the oil industry, but may cause a major disruption for crude oil producers, oil refiners and the consumer during its implementation.

The new regulation will increase the demand for new low-sulfur bunker fuels at the expense of high-sulfur bunker fuels.

For Mexico, the problems are twofold. First, Mexican crude oil production is generally a heavy grade of crude oil that is high in sulfur content and its price may come under pressure in 2020. Second, the Mexican refining system produces a large percentage of fuel oil that previously was sold into a high-sulfur bunker market where future demand is being cut in half, which will cause disposition headaches.

Ultimately, the questions for the oil industry are where the new low-sulfur fuel will come from, where will the high-sulfur fuel go, and what is the industry going to do about it?

Reducing Sulfur Emissions
Most vessels burn high-sulfur bunker fuels which by their very nature lead to sulfur oxide emissions. Reducing sulfur emissions reduces air pollution, reduces acid rain, and lowers the amount of particulates that enter the atmosphere when this heavy fuel is burned. Studies have found that these emissions lead to premature deaths and child asthma. The purpose of the regulations is to reduce these environmental and health hazards.

According to the International Maritime Organization (IMO) website, “IMO regulations to reduce sulphur oxides (SOx) emissions from ships first came into force in 2005, under Annex VI of the International Convention for the Prevention of Pollution from Ships (known as the MARPOL Convention).”

In 2005, IMO required that the maximum sulfur content of any marine fuel would be capped at 4.50%. Previously there had been no cap on the sulfur content. Since most of the fuel oil consumed by vessels was below this level, the market impact was small.
Then in 2008, IMO revised the sulfur cap to 3.5% effective 2012 with a further reduction to 0.5% effective 2020. At the same time, IMO established emission control areas (ECAs) with more-stringent sulfur specifications for fuel burned in these territorial waters. The ECAs more or less encompassed parts of Northwest Europe and North America. Prior to July 2010, the sulfur content in the ECAs was set at 1.5%. From July 2010 to July 2015, the sulfur cap was reduced to 1.0% and from July 2015, the standard was then reduced to 0.1%.

Due to the limited volumes of bunker fuels burned in the North American and Northwest Europe territorial waters, there was no great disruption in the bunker markets prior to July 2015. However, since the majority of residual fuel produced at refineries has sulfur content greater than 0.1%, vessel owners began burning more distillate fuel rather than the residuum-based bunker fuel in order to meet the ECA regulations.

The small demand change from residual fuel to distillate fuel that was felt in 2015 was limited in geographic area. Today, the IMO 2020 regulations are seen making a worldwide impact, resulting in a significant amount of switching from high-sulfur residuum-based fuel to a distillate-based 0.5% sulfur-compliant fuel.

What Vessel Owners Are Doing

There is a wide range in the estimates for the volume of high-sulfur bunker fuel demand, from as low as 3.2 million b/d to over 4.0 million b/d. For purposes of this discussion, I use 3.5 million b/d for demand.

IMO 2020 regulations require vessel owners to reduce sulfur emissions. They can accomplish this in two ways. The first way is to install a scrubber which removes sulfur emissions from the exhaust gases resulting from the fuel burn. The second is to burn compliant low-sulfur fuels with a maximum sulfur content of 0.5%.

Each vessel owner must decide whether or not to make the $1 million to $4 million capital investment to install a scrubber. The scrubber investment allows the ship owner to burn the cheaper high-sulfur fuel rather than the more expensive low-sulfur compliant fuel. One can see that the larger the price difference between the two fuels, the greater the incentive for a ship owner to invest in a scrubber.
There is much debate among ship owners as to whether they should invest or not. They need to make a market call on what the price difference between the two fuels will be and how long that difference may last until something changes in the oil market.

There is also a wide range in estimates of the number of vessels that are in service around the world, and how many are suitable for a scrubber installation. Scrubbers take up space so are not suitable for the thousands of very small vessels. On the other hand, vessels that are 20 years old that are reaching the end of their useful life are not good candidates for additional investment.

Of the more than 40,000 vessels that may be suitable candidates for scrubber installation, just over 2,000 will have scrubbers installed by Jan. 1, 2020. Those 2,000 vessels will consume about 650,000 b/d of high-sulfur fuel oil.

Vessels with no scrubbers must burn compliant fuel beginning Jan. 1 and furthermore are not allowed to carry high-sulfur bunkers in their fuel tanks beginning March 1, 2020. This means that vessels must now consider when their transition to compliant fuel must begin. Since no ship owner wants to be in the position of carrying high sulfur fuels after Jan. 1 and must then debunker to liquidate that onboard inventory, it is likely that these scrubber-less vessels will enter into the compliant fuel market in October 2019 to ensure that they fully consume their high-sulfur fuel inventory by Jan. 1, 2020.

As a result, the spread between low-sulfur complaint fuels and high-sulfur bunker fuels is expected to react and widen in October as the demand switch to low-sulfur from high-sulfur fuels materially impacts the market.

What Refiners Are Doing

The IMO 2020 regulation does not require refiners to do anything. Refiners need to make a decision, like vessel owners, as to whether or not they should make a capital investment in their refineries in order to reduce the production of high-sulfur bunker fuels, demand for which is dropping, and instead upgrade it into compliant fuel, demand for which is increasing.

Unlike the scrubber investment, refinery investments are far more capital intensive and construction of grass roots processing units can take four or five years to commission. There are three technologies for refiners to upgrade this bottom-of-the-barrel residuum. Cokers, at a capital cost of $800 million to $1 billion with a four-year construction timeline, may be built. Valero is constructing a unit in Port Arthur, Texas (expected to start up in 2022), while Marathon Petroleum just canceled its project in Garyville, La. In Mexico, the Tula coker, which began construction in 2014, is now short of funds to continue and may not be on line until 2021 or later.

The second technology is residual fuel desulfurization. In Korea, SK Innovation is constructing a 30,000-b/d unit at a cost of nearly $900 million. Finally, solvent deasphalting units are a less-expensive investment; they reduce the volume of high-sulfur bunker fuels, but what remains is a material that is quite difficult to blend due to its asphaltic nature.

Looking at all the refinery investments that are to be commissioned prior to January 2020 leads me to conclude that refiners will upgrade 700,000 bbl of residuum. While other investments are underway, they will not be on line at the start of 2020, which will lead to an imbalance of high-sulfur fuel oil supply and its demand.

Of the 3.5 million b/d of high-sulfur bunker fuel demand, only 1.35 million b/d has been accounted for. Now what? Where will the compliant fuel come from? And where does that leave Mexico?

High-Sulfur Bunker Fuel Disposition

As the Jan. 1, 2020 implementation date nears, the market has good information regarding vessel scrubber installation and refinery projects. What is less clear is how and where the remaining 2.15 million b/d will be handled.

IMO 2020 is a worldwide regulation, and enforcement is left up to individual countries. Some amount
of non-compliance is expected as vessel owners may opt to burn high-sulfur fuel oil to save money while not investing in scrubbers. Because the majority of bunker fuel is sold in a half-dozen ports around the world and large-vessel owners make up most of the fleet, it is anticipated that compliance will be rather high – 85%. This leaves 15%, or 525,000 b/d, of high-sulfur bunkers consumed by those who don’t comply with the regulation.

Fortuitously, while the IMO has currently capped the sulfur content of high-sulfur fuels at 3.5%, the actual average sulfur content of marine bunker fuels is closer to 2.6%, which means that some of this high-sulfur material may be blended into the new compliant fuel. Blending is estimated to account for an additional 300,000 b/d. When Pemex produces high-sulfur fuel oil for the market, the sulfur content is generally over 4.1% because the product is made predominantly from Maya crude oil.

One can see that blending this fuel oil into compliant fuel requires a significant amount of dilution. In fact, one 300,000-bbl cargo would need to be blended with over 2 million bbl of virtually zero-sulfur-content, ultra-low-sulfur diesel to produce 0.5% compliant fuel. Solution by dilution is not a practical answer for Pemex fuel disposition; the fuel needs to be sold to scrubber-equipped vessels.

Finally, additional quantities of high-sulfur fuel may be diverted to the utility market, especially in the Middle East, while sanctions on Iran limit the amount of high-sulfur fuel oil that is able to reach other markets. These types of effects are estimated at 500,000 b/d.

The bottom line is that of the 3.5 million b/d of high-sulfur fuel oil currently consumed by the marine industry, 2.7 million b/d appears to have a disposition, leaving 800,000 b/d seeking an outlet. That means the high-sulfur price will go down and as the price falls, refiners are willing to pay less for the heavy crude oil that the bunker fuel is produced from.

This is bad news for Mexico because the country is long high-sulfur bunkers and high-sulfur Maya crude oil. Ironically, the higher Mexican refinery utilization goes, the more fuel oil that is produced. In fact, according to monthly Pemex petroleum statistics, in 2018, fuel oil accounted for 25% of the refinery product mix. Contrast that to refineries in the U.S., where according to the Energy Information Administration residual fuel oil yield in 2018 was less than 2.5%.

**Low-Sulfur Compliant Fuel Supply**

The decline in demand of high-sulfur fuel oil must be made up with an increase in demand for compliant fuel. Of the 3.5 million b/d of bunker demand, scrubber demand, non-compliance and blending of high-sulfur fuels amount to 1.475 million b/d, leaving the market to come up with nearly 2 million b/d of compliant fuel.

Some of that shortfall will come from the refinery upgrades that convert the bottom of the barrel into other fuels. However, the market believes that the majority of the new compliant fuel in the near term
will be distillate based. Some supplies will come from refiners diverting other low-sulfur feedstocks such as vacuum gasoil into the marine market. Other supplies will come from newly commissioned refineries in Asia.

As the marine market's demand for distillate increases, so too does its price. This is happening at the same time that refinery operations in Mexico need to improve. According to Pemex statistics, distillate production in 2014 was 286,000 b/d, and that fell to 119,000 b/d during the first three months of 2019. The shortfall has been met with ever-increasing imports.

**Logistics and Distribution**

In between the refiner and vessel owner sits the terminal distribution system. Those companies will need to decide how much tankage to allocate for both low- and high-sulfur fuels as there will be demand for both.

Major bunker locations such as Singapore, Rotterdam and Houston will have adequate storage facilities. Many ports will have to decide how to arrange their tankage and may only have enough storage to handle one grade of heavy fuel.

If a significant number of ports decide to carry only low-sulfur compliant fuel, the result would be further deterioration in high-sulfur bunker demand.

**IMO 2020 and Mexico**

The IMO 2020 regulation will have a considerable impact on the Mexican oil industry. As the world looks to manufacture additional quantities of low-sulfur compliant fuel, the demand for low-sulfur crude oil at the expense of high-sulfur crude will increase. That will put pressure on the price of Maya crude oil relative to the price of light sweet crude oils such as Brent or West Texas Intermediate.

On the other hand, the demand for high-sulfur bunkers will decline precipitously and Mexican refineries produce a lot of it. The biggest issue facing these refineries is finding a sales outlet.

Finally, the new compliant fuel that the marine markets demand will be distillate-based. With Mexican refinery utilization hovering between 30% and 40%, diesel production has declined while imports have soared, impacting the country's trade balance. For Mexico, the long-term solution lies in improving refinery utilization and investing in upgrading equipment to minimize production of a fuel that the world is moving away from.

![Mexico Diesel Supply](chart)

Source: SIE, SAT

---

**Mexico Diesel Supply (includes private imports beginning March 2018)**

![Chart: Mexico Diesel Supply](chart)