REDUCING SULPHUR EMISSIONS
- a joint effort
Reducing Sulphur Emissions - a joint effort

Since 2006, the IMO convention MARPOL Annex VI “Prevention of Air Pollution from Ships” set general limits on sulphur content in ship fuel. It also enabled the creation of Sulphur Emission Control Areas (SECA) with maximum sulphur limits of 0.1% for SOx, in place since 1st of January 2015 in Europe and North America.

Sulphur emissions are a proven threat to health and the environment, yet most of the busiest ports on the planet are not within a SECA today. In lieu of more uniform regulation, the reduction of sulphur emissions in port cities is being managed by individual countries, port authorities and vessel owners and operators.

Shipping – The Best of a Bad Bunch?

Whereas CO2 emissions of shipping are only a fifth of those of road transport, NOx and PM emissions are almost on a par, and SOx emissions of shipping are substantially higher. Produced during combustion, roughly 90% of the sulphur content in a vessel’s fuel reacts with oxygen in the engine and is then released within the exhaust gas as sulphur dioxide.1

Therefore, it’s no surprise that the industry, which still runs on sulphur rich bunker fuel leads the way with sulphur emissions. Generating approximately 80 times more SOx emissions than the aviation industry (Eyring et al 2003) emissions from shipping are also substantially higher than those of road transport, by a factor of between 1.6 and 2.7 (ICCT, 2007). 70% of international shipping’s emissions occur within 400 km of coastlines, along the main trade routes, with several studies indicating that shipping emissions can also travel up to hundreds of kilometres inland as a result of land-sea winds (NDRC 2014).

Damaging to health and the environment, estimates vary significantly on shipping’s actual share of worldwide SOx emission totals with the IMO estimating 4% compared to Eyring et al’s 9%. Country-by-country the picture is no clearer, but the most recent figures released by China, home to seven of the ten largest ports by container throughput, credits 8.4% of its total SOx emissions to shipping.

For Shanghai, the world’s largest port, the latest emissions inventory from the Shanghai Environmental Monitoring Center indicates emissions from ships and port activities (including emissions from drayage trucks and cargo handling equipment) accounted for 12.4% of the city’s SO2 emissions.

Preventable cause, unknown effects

While the source of emissions is easy to pinpoint, the long-term effect of SOx emissions have proven more difficult to determine. However, the considerable amount of evidence collected by the US Environmental Protection Agency (USEPA) links short-term exposure to SO2, ranging from just 5 minutes to 24 hours, with an array of adverse respiratory effects including bronchoconstriction and increased asthma symptoms.

SOx can also react with other compounds in the atmosphere to form small particles. Able to penetrate deeply into sensitive parts of the lungs, these particles can cause or worsen respiratory disease, such as emphysema and bronchitis. It can also aggravate existing heart disease, leading to increased hospital admissions and premature death.

Albeit a difficult measurement to gauge, several studies have looked at the number of premature mortalities caused by vessel emissions. Notable studies from USEPA asserts that the implementation of an ECA around most of the U.S. coastline will help eliminate up to 31,000 premature deaths by 2030. In addition to its effects on health, sulphur deposits can also cause acidification, which alters biogeochemistry and affects animal and plant life.

Location, location, location

Responding to these concerns with revisions to Annex VI of the International Convention of 2006 for the Prevention of Marine Pollution from Ships (MARPOL), the IMO set about controlling shipping’s SOx emissions through a global sulphur cap of 35,000 ppm (3.5%) sulphur for bunker fuel.

Recognising the threats posed by sulphur emissions, Wallenius Wilhelmsen Logistics (WWL), launched its own global policy in 2005 limiting the average sulphur content in the fuel used by its fleet to just 1.5%. This was significantly lower than the IMO levels at the time and the industry average, which was a sulphur level between 3.5% - 2.7%.

Anna Larsson, Global Head of Sustainability at WWL illustrates just what the company’s stance on emissions has achieved. “We have avoided releasing ca 220,000 tonnes of sulphur into the atmosphere due to our voluntary sulphur restrictions. To put that into perspective, that is nearly the total amount of sulphur emitted in France in 20122. Reduction technologies, such as wet or dry scrubbers, were also approved as an alternative route to sulphur compliance. This allowed vessels to continue using heavy bunker fuels safe in the knowledge their exhaust gases would be cleaned prior to being released.

However; scrubbers requires significant capital investment, so the take-up has been relatively low, with the switchover to low sulphur fuel currently the preferred option for most shipping companies. MARPOL Annex VI also initiated the creation of sulphur emission control areas or SECAs. Clearly defined and requiring the switch to an even lower sulphur fuel, the emission control areas established under MARPOL Annex VI for SOx are:

- The Baltic Sea area
- The North Sea area
- The North American area (covering designated coastal areas off the United States and Canada)
- The United States Caribbean Sea area (around Puerto Rico and the United States Virgin Islands).

New maximum sulphur limits of 1,000 ppm (0.1%) came into force on the 1st of January 2015 for all established SECAs. Despite the unanswered questions regarding enforcement, overall the SECAs and new limits have been shown to achieve significant sulphur reductions in the coastal areas concerned. Still a work in progress, the IMO’s global sulphur emission limits are set to be reduced once more down to 5,000 ppm (0.5%) by 2020/2025.3

Nonetheless, there is an obvious problem. Outside of existing, IMO-sanctioned ECAs, the maximum sulphur content of fuel is still 3.5%, and that figure stands irrespective of whether the vessel is slow steaming across the Atlantic or berthed in a densely populated port city. The National Resources Defence Council (NRDC) whose work was influential in helping to cut emissions in the US ports of Long Beach and Los Angeles puts it quite
simply. “While large cargo ships are required to use clean fuel as they approach U.S. and Canadian ports, they are allowed to switch back to bunker fuel—one of the dirtiest fuels in the world—on their way back to China”. A bizarre situation whereby emissions are strictly limited in one country or region’s ports and not the next, irrespective of size or population density the implications are concerning.

A tale of two cities

For example: of the top ten ports, as measured by container volume, not a single one sits within one of the four ECAs. Of the top twenty, just five ports reside in an emission control area. For WWL, 49 of its 79 main trading ports lie outside of a designated ECA and the 23 of 24 ports the company visit less frequently on its scheduled routes are not in an emission control zone either.

Looking closer at the make-up of some of the largest port cities, it is alarming that China’s seven largest port cities also have the highest population density among all major port regions. In addition, the ports with the largest shipping emission totals are Singapore, Hong Kong (China), Tianjin (China) and Port Klang (Malaysia) all but one large, highly populated port cities.

In the case of China the authorities have worked hard to regulate emissions from both vehicles and industry. The air quality challenges remain, especially in port cities, and the Ministry of Transport have recently announced domestic sulphur regulations for ships as a next step towards improvement.

You are now entering an emission control free area

With the detrimental sulphur effects clearly documented, you would assume the formation of country and continent-wide IMO approved ECAs covering the rest of the world’s ports would be just around the corner. Sadly, you would be wrong.

Requiring agreement from all the participant MARPOL Annex VI signatory countries in the case of a region-wide ECA, along with the submission of emission inventories the entire assessment and consultation process typically takes five years to complete. At the time of writing, the IMO confirms that they have ‘no proposals for designation of new ECAs’ from either individual countries, or regions. The first obstacle, when it comes to region-wide regulation at least, is unsurprisingly, consensus. The much-discussed Mediterranean ECA for example is still just at the discussion stage. Head of Port Operations and Planning at the Port of Barcelona, Jordi Vila states, “The realization of a Med ECA is very difficult because the ECA designation has to be unanimous in the [International Maritime Organization] and will be very hard to achieve”. The second obstacle is financial.

Many emerging economies, and indeed some established ones, see designating their territorial waters an ECA as dulling their ports’ current competitive edge. While this may seem far-fetched, in the current financial climate favouring ports that don’t require vessels to switch to more expensive distillate fuel will make perfect financial sense to many operators. However, despite the difficulties, several countries have made positive steps to reduce SOx emissions.

Own waters, own rules

For example, The Turkish Chamber of Shipping and the Turkish General Directorate of Marine Transport in September 2011, set out the new requirements which came into force January 1st 2012. In line with IMO guidelines for ECAs, all vessels arriving Turkish ports and all inland waterway vessels sailing on Turkish inland waters must use fuels at or below 0.1% sulphur.

Australia has also taken, albeit small, steps of its own to reduce SOx emissions, with the port of Sydney imposing a 0.1% sulphur limit as of April 1st 2016. Ships are also encouraged to use fuel with a sulphur content not exceeding 0.1% whilst berthed.

As of 1 January 2016, ports inside the three emission control areas may request ships to use low sulphur fuel or other measures while at berth. Shanghai was first out, introducing a 5,000 ppm sulphur limit as of April 1st 2016. Ships are also encouraged to use fuel with a sulphur content not exceeding 0.1% whilst berthed.

Investing early in low sulphur

While countries and individual ports setting their own emission controls, outside the IMO ECA designation scheme, is to be applauded, operators and owners can also be more proactive in helping to cut sulphur emissions. Whether it is through the voluntary use of low sulphur fuels when at berth, investment in abatement technologies, or a wholesale shift to the next generation of marine propulsion, progress does come at a cost.

With the current price difference between Heavy Fuel Oil (HFO) and Marine Gas Oil (MGO) approximately USD 180 MT and the price tag attached to the purchase and installation of a scrubber estimated to begin at 1 million USD arbitrarily lowering sulphur emissions is currently an expensive business.

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<thead>
<tr>
<th>Top 10 ports (SOX emissions)</th>
<th>Share of total</th>
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<tbody>
<tr>
<td>1. Singapore</td>
<td>6.5%</td>
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<tr>
<td>2. Hong Kong</td>
<td>2.3%</td>
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<tr>
<td>3. Port Klang</td>
<td>2.2%</td>
</tr>
<tr>
<td>4. Tianjin</td>
<td>2.1%</td>
</tr>
<tr>
<td>5. Shanghai</td>
<td>2.0%</td>
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<tr>
<td>6. Fujairah</td>
<td>2.0%</td>
</tr>
<tr>
<td>7. Busan</td>
<td>1.7%</td>
</tr>
<tr>
<td>8. Kaohsiung</td>
<td>1.6%</td>
</tr>
<tr>
<td>9. Ulsan</td>
<td>1.0%</td>
</tr>
<tr>
<td>10. Beilun</td>
<td>0.9%</td>
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<tr>
<td>Total Top 10</td>
<td>22.3%</td>
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However, with the regulatory landscape changing rapidly from port to port and region to region and the IMO’s 2018 feasibility study fast approaching for the proposed global 0.5% cap, early adopters already imposing their own low sulphur limits could be viewed as ahead of the curve. WWL are one such company who have seen the need to introduce a new low sulphur policy that takes into account the human health factor as well as the environment.

As of March 1st, all of its vessels are operating with fuel of 0.1% sulphur or equivalent at berth, in all ports across the globe, no exceptions, no exemptions.

Accomplished through either the use of MGO or abatement technology, depending on the vessel, to ensure safe implementation and for sake of simplicity, the policy is implemented in accordance with the principles that apply for EU ports outside ECA zones. So WWL’s vessels will operate with <0.1% sulphur or equivalent within 2 hrs at berth and the changeover of fuel will be done in all engines and boilers on board which are kept running while at berth.

Supporting their operational commitment to lower sulphur emissions WWL are also one of the owners to have registered with the World Ports Climate Initiative who have developed a very public Environmental Ships Index quantifying vessels’ emissions performance.

An online resource, owners and operators self-declare providing fuel consumption and voyage information enabling a basic emissions calculation and associated score to be generated. A voluntary scheme, emission auditing could well prove to be another significant driver of at berth emission reductions.

“Human life is worth the same everywhere and if WWL can follow a <0.1% sulphur limit at berth in one part of the world, then we can follow it in all ports, wherever they are”.

- Anna Larsson, VP, Global Head of Sustainability WWL

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Notes

1. A smaller portion of the sulphur in the fuel forms SO3. The abbreviation SOx is thus often used (SOx = SO2 + SO3).


3. An IMO feasibility study due in 2018 will indicate if there are sufficient quantities of low sulphur fuel available to sustain the market.
