

Ship emissions

Monitoring, enforcement and human health

Air pollution from ships is a serious problem that doesn't get enough attention. Kelvin Boot explains how environmental science can help ensure industry plays by the rules.

Europe has an estimated 80,000 ship-visits to ports each year, and many of those ships burn cheap, low-quality fuel that creates polluting exhaust emissions, containing sulphur, nitrogen oxides and particulate matter. This thick, dirty, tar-like fuel oil is what's left behind after the crude oil has been refined into petrol and other petroleum products.

The millions of tonnes of polluting chemicals ship exhausts emit are identified as causing or contributing to lung and heart disease and cancers, leading to around 50,000 human deaths a year in Europe – so there is no doubt pollution from shipping is a serious problem. Whilst these emissions can affect the climate and modify atmospheric chemistry when out at sea, it is when the ships are in coastal waters and ports that they directly threaten human health.

Regulation is easy, enforcement is hard

To reduce the impact of ship emissions, the International Maritime Organization (IMO) introduced new regulations in January 2015. These aimed to reduce maximum open-ocean

emissions of sulphur dioxide (SO₂) from the then current level of 3.5% of the total mass of fuel to 0.35% by 2020.

Near the coast the IMO designated Sulphur Emission Control Areas (SECAs) including the English Channel and surrounding European waters; here, maximum sulphur content must fall to 0.1% by mass by 2015. Complying could add thousands per day to each

ship's fuel bill! Some global shipping companies have taken the regulations seriously, but others will want to avoid extra expense. Figures suggest only one in a thousand ships is checked in port – and of those around half failed testing.

A reference point for future emissions

Researchers at Plymouth Marine Laboratory,

who took continuous atmospheric measurements at the Penlee Point Atmospheric Observatory (PPAO), spotted an opportunity to assess the success of the IMO Regulations. The PPAO site is on the western side of the English Channel, a busy shipping lane and a designated SECA. Measurements started seven months before the 2015 regulations came into force, providing a reference point for future changes in emissions.

Dr Tim Smyth, Dr Mingxi Yang and colleagues operate the PPAO as part of the NERC-funded Western Channel Observatory. What the data told them was clear. 'We found that the SO₂ mixing ratio in southwesterly winds from the Atlantic was generally low and showed a daily cycle that is largely consistent with dimethyl sulphide oxidation – a naturally occurring part of the sulphur cycle over the ocean,' Yang explains. 'When analysing emissions carried by southeasterly winds from the Channel things were quite different; they were elevated and SO₂ mixing ratios were more variable. We interpret this being due to an additional contribution from ships, which were far more numerous in that part of the English Channel. In 2015, we witnessed a three-fold reduction in this ship contribution compared to 2014, suggesting a high level of compliance (>95%) with the IMO regulations for ships near Plymouth.'

Smyth also sees much wider potential in applying the technology to ensuring compliance with pollution regulations. 'We are working with industrial partners to develop an on-ship monitor that will link with the tracking system used on ships to report back ship identity, position and emissions composition to ground stations for scrutiny and hopefully avoidance of non-compliance by the ship's operators,' he says. 'It's an excellent example of science becoming relevant to a real world challenge.'



Kelvin Boot is a science communicator working with organisations including Plymouth Marine Laboratory. To find out more about PPAO visit www.westernchannelobservatory.org.uk/penlee.

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