

# **Ships in the English Channel have highest rate of sulphur violations in northern Europe**

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Emissions from shipping traffic are monitored using physical/chemical analysis through a "sniffer" on the Oresund Bridge. Credit: Jörg Beecken

Researchers at Chalmers University of Technology have shown that between 87 and 98 percent of ships comply with the tougher regulations for sulphur emissions that were introduced in northern Europe in 2015. The lowest levels of compliance were observed in the western part of the English Channel and in the middle of the Baltic Sea.

The highest permitted [sulphur](#) content in shipping [fuel](#) was drastically reduced at the end of 2014 for vessels sailing in the northern European Sulphur Emission Control Area (SECA) - from 1.00 to 0.10 percent. Before the stricter regulations were implemented, sulphur emissions from the shipping industry were estimated to cause the premature deaths of 50,000 Europeans each year, because sulphur forms particles that are swept inland by the wind.

Researchers at Chalmers University of Technology, Sweden, have developed a groundbreaking method for remotely monitoring emissions from marine vessels, which they've used to investigate the effects of the new regulations. The work has been carried out through the Danish Environmental Protection Agency and the EU projects Compton and Envisum.

Some of the measurements were taken using an aeroplane flying over Denmark, the English Channel and the middle of the Baltic Sea, while others used fixed measuring stations in the approach to Gothenburg, Sweden, on the Oresund Bridge (between Copenhagen and Malmo) and on the Great Belt Bridge in central Denmark.

Johan Mellqvist, professor of optical remote sensing, heads the work at

Chalmers. "We can see differences in how the regulations are followed depending on who owns the vessels," he says. While the vast majority of the ships comply with the regulations, a few shipping companies seem repeatedly to use non-compliant fuel.

"Other patterns we can see are that vessels that only rarely come into these waters break the rules more frequently. In addition, it's more common that vessels emit excessive sulphur as they are leaving the SECA rather than on the way in, when they risk an on-board inspection. Some ships that have installed abatement technique for sulphur, so-called scrubbers, have been observed with high levels on multiple occasions."

One use of remote sensing is to advise port authorities as to which ships they should select for on-board fuel inspections. Such inspections are a prerequisite for taking legal action against rule breakers. Recently, the Norwegian Maritime Authority fined a ship NOK 600,000 (about EUR 63,000) for noncompliance. This was detected by the Great Belt measuring station and reported to the Norwegian Authorities.

"In general, the vessels carry both low-sulphur fuel oil and the less expensive high-sulphur oil on board," Mellqvist says. "If they switch fuel well in advance of their passing of the measuring stations, they won't be caught out. That's why aerial monitoring is superior. It shows how much the vessels actually emit when they are out at sea and don't know that they will be monitored."

The aerial surveys show that 13 percent of vessels in the western part of the English Channel, near the SECA border, were in violation of the sulphur regulations in September 2016. For vessels around Denmark, the corresponding figure is 6 to 8 percent, depending on time period. The fixed measuring stations on the approach to Gothenburg, on the Oresund Bridge and the Great Belt Bridge show that between 2 and 5 percent of

the bypassing ships use non-compliant fuel. This can be compared to on-board inspections showing non-compliance rates of around 5 percent of the vessels at port. This may indicate that some ships change to compliant fuels too late (when entering the SECA) or change to non-compliant fuels too early (when leaving the SECA), while aiming at compliance at the fixed stations where they expect to be observed.

"There is a strong financial incentive for shipping companies to continue using the prohibited high-sulphur fuel," Mellqvist says. "For example, they can save around 100,000 euros by using the cheaper, high-sulphur fuel on a single round trip between the U.K. and St. Petersburg. The entirety of this journey lies within the SECA."

On Friday, March 23, Johan Mellqvist will present the ship surveillance work at the 19th International Environmental Forum "Baltic Sea Day" 2018 in St Petersburg, describing results from surveillance flights last summer in the middle of the Baltic Sea. The preliminary results show that the compliance rate was 88 percent, which is lower than in the western part of the Baltic Sea.

The method that the Chalmers researchers have developed is based on a combination of established technologies that have been refined and adapted. They include [optical remote sensing](#), physical/chemical analysis using a "sniffer" and monitoring vessels using an Automatic Identification System (AIS). In addition to sulphur, the system can analyse marine emissions of nitrogen oxides and particles, for which the regulations have also been tightened for the shipping industry in recent years.

The method was completely unique when it came, and it is gaining ground in the industry. For example, the Chalmers team has built an aerial surveillance system for monitoring air pollution in Belgium. They've also conducted a pilot project in Los Angeles and maintain



regular contacts with China, where the detection technique is about to be implemented.



The inside of the sulphur-detecting plane. The sniffer is the big box on the left. Credit: Johan Mellqvist

Sulphur emissions are above all a health issue, but in the Nordic region, where the bedrock has low lime content, they also contribute to acidification in lakes and waterways. Since 2015, the Baltic Sea, the Kattegat, the Skagerrak, the North Sea and the English Channel have made up a Sulphur Emission Control Area in which shipping fuel may contain no more than 0.1 percent sulphur. The rest of the EU follows the regulations set out by the UN's International Maritime Organisation, IMO, which will reduce the maximum permitted sulphur content in

shipping fuel from the current 3.5 percent to 0.5 percent worldwide by 2020.

Reducing sulphur emissions is very costly for shipping companies, no matter how they choose to meet the requirements. There are several alternatives:

- Powering ships with the significantly more expensive low-sulphur heavy fuel oil (HFO).
- Installing scrubbers on board to reduce sulphur emissions to the necessary degree.
- Switching fuels entirely, for example to liquefied natural gas (LNG) or methanol, which the ferry company Stena Line is now testing on a few of its [vessels](#).

## The research

The results come from measurements that the Chalmers researchers carried out on the behalf of the [Danish Environmental Protection Agency](#) and the recently completed EU compliance monitoring project Compmon. The report from Compmon was published end of December 2017 (<http://dx.doi.org/10.17196/CompMon.001> and <http://dx.doi.org/10.17196/CompMon.002> )

The EU project Envisum is currently investigating the health benefits created by the new regulations in the countries around the Baltic. Chalmers University of Technology, Gothenburg University and City of Gothenburg are some of the participants. The project focuses particularly on health effects in Gothenburg, St Petersburg and Gdynia-Gdansk—some of the biggest ports in the area, which are centrally located in their respective cities.

**More information:** [DOI: 10.17196/DEPA.001](https://doi.org/10.17196/DEPA.001)

Provided by Chalmers University of Technology

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