

Development and application of a sensor for measurements of organic particles from shipping

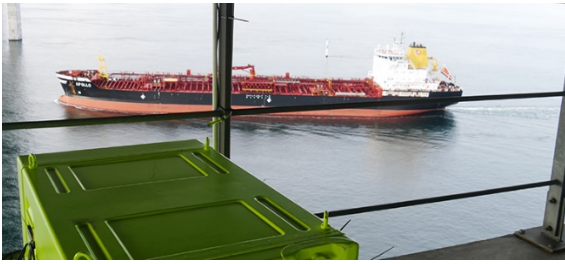


Figure 1. The Chalmers IGPS sniffer system. This system automatically derives sulfur content of by passing ships by analyzing the exhaust gas composition remotely.

Background

Several research studies using advanced instrumentation show that ships emit significant amounts of organic compounds and that these dominate the total particle emissions in the exhaust. The particulate emissions are presently not being removed by abatement technology and there is little discussion about their adverse impact on environment and health. This is in contrast to the land-based sector in which all new diesel vehicles are obliged to utilize abatement technology which removes a considerable portion of these particles. Some studies propose that these particles mainly consist of volatile material originating from lubrication oil, and it is very difficult to measure these with simple instrumentation. During the last 5 years, remote ship monitoring at several sites of sulfur dioxide by Chalmers/SEE, have shown measurement artifacts in some of the instruments due to sticky substances in the ship plumes. It is believed that these are caused by organic compounds in the ship plumes, present either in gaseous or particulate phase. It could be a possibility to utilize this artifact as a measure of the amount of organic particles emitted by ships in a very cost-effective way. However, it would require a combination of several instruments/competences and an interdisciplinary approach to progress the understanding on this and, if possible, make the measurements quantitative. See: <https://www.chalmers.se/en/departments/see/news/Pages/Ships-in-the-English-Channel-have-the-highest-rate-of-sulphur-violations-in-northern-Europe.aspx>

What is the project about?

The main work will be focused on developing and testing the fundamentals for a new simple sensor for measurements of organic pollutants that can be used to minimize such emissions in various situations. The sensor will be calibrated by a more advanced method based on Chemical Ionization mass spectrometry (CIMS) and infrared spectroscopy (FTIR) in collaboration with Göteborg University. The sensor will be tested in a field trial at Älvsborgs-fästning and in a ship test engine. The main objectives of the work are:

- Analyze the chemical composition of organic particles and gases in exhaust gases from ships
- Develop a new simple instrument for ship emission measurements of organic particles
- Measure emissions of organic particle and gases from ships in real traffic and a ship engine.
- Data analysis, and reporting

The main outcome of this important work will increase the scientific understanding of emissions of organic particles from ships in operation and investigate methods how to abate and control these emissions. This may have significant policy impact. The focus of the work will mainly be scientific but with strong technical focus wrt to the new sensor.

Requirements

- Data analysis
- some programming experience (matlab, python and possibly C)
- ability to solve practical problems
- interest to do field-work

Supervisor

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