European Metrology Programme for Innovation and Research

Delivering Impact

Improved metering to support green fuels in the maritime industry

Maritime transport is one of the biggest industries in the world, encompassing both passenger services and freight. As the industry transitions toward greener fuels, in response to legislation restricting maritime emissions, new metrological and methods are needed to ensure accurate fuel consumption and emissions measurements.

Europe's National Measurement Institutes working together

The European Metrology Programme for Innovation and Research (EMPIR) has been developed as part of Horizon 2020, the EU Framework Programme for Research and Innovation. EMPIR funding is drawn from 28 participating EURAMET member states to support collaborative research between Measurement Institutes, academia and industry both within and outside Europe to address key metrology challenges and ensure that measurement science meets the future.

Challenge

In 2021, the European Commission adopted the EU Action Plan "Towards a Zero Pollution for Air, Water and Soil" - a key deliverable of the European Green Deal. As the maritime sector accounts for 14 % of the EU's CO_2 emissions from transport, regulations like the FuelEU Maritime Initiative (adopted in 2022) have been created to tighten emission requirements and fuel consumption limits. This has led to a focus on alternative low- or zero-carbon fuels and improved engine testing. To support this transition, new metrology was needed to improve flow measurements, which have a direct impact on the quality of fuel consumption determination and emissions measurements.

One of the factors affecting maritime flow measurements is the variety of fuels used. Some, such as green methanol, have viscosities similar to water at room temperature (1 centistokes at 20 °C), while others must be heated before they can burn and remain relatively viscous. Heavy fuel oil, for example, can have a viscosity of up to 700 centistokes, similar to cooking oil, at 50°C. These properties can affect the measurement uncertainty of common types of flow meters which, along with environmental influences such as temperature and vibration, can lead to inconsistent measurements.

Solution

During EMPIR project SAFEST, project partner AVL developed a new prototype for a servo-controlled positive displacement (PD) flow meter tailored to maritime applications. The meter works by repeatedly displacing a fixed volume of liquid between a system of gears. The number of displacements is then counted over a known period to find the flow rate. The meter has high accuracy and is unaffected by fuel viscosity or density. It also does not require a specific orientation of the surrounding pipework and, due to its robust design, is less sensitive to external factors. This means flow measurements can be made under complex conditions with consistent measurement uncertainty, whether using heavy fuel oil, green methanol or any fuel between. During the project, the PD flow meter was assessed using testbenches at RISE, the National Metrology Institute (NMI) for Sweden, and PTB, the NMI for Germany, allowing AVL to optimise its design and ensure traceability to the SI.

Impact

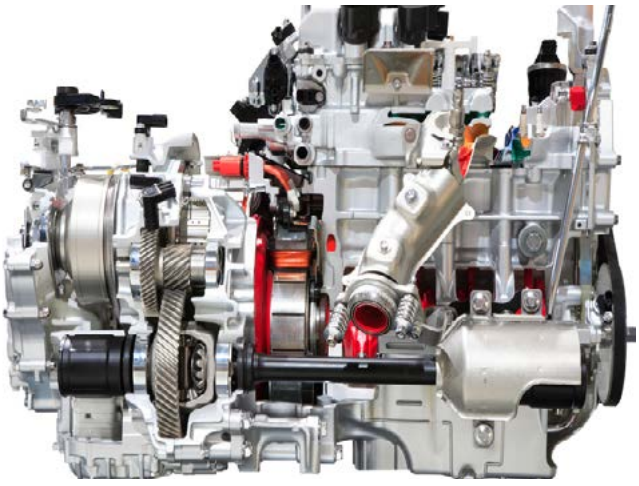
AVL, based in Graz, Austria, is a world-leader in mobility technology in the automotive and rail industries. More recently, the company has expanded its operations to include maritime transport. The work of the SAFEST project has allowed AVL to develop the new PD flow meter beyond the prototype stage. The company has now initiated type approval with a classification society, who specify the materials and other requirements needed for maritime products. At the same time, AVL is also collaborating on a project with Wismar University of Applied Sciences in Rostock, Germany, using the new meter to conduct flow measurements on diesel dosed with green methanol, a fuel alternative with lower carbon dioxide (CO_2), particle and nitrous oxide (NOx) emissions.

The work of the SAFEST project and the development of the new PD flow meter will contribute to improved flow measurements across the maritime industry, providing better accuracy and useability. In the long-term, this will aid the transition towards greener fuels and reduced emissions, aiding Europe in its ambitions towards zero pollution.

Developing metrology to improve flow measurements in the transport sector

To support tightened emission requirements brought in by new EU legislation and the transition to alternative, low-carbon fuels across the automotive and maritime industries, the SAFEST project has developed advanced metrology for flow measurements. This includes:

- New test rigs for generating and measuring dynamic flow changes, evaluated in an interlaboratory comparison using newly developed and characterised transfer setups
- Protocols for a dynamic test regime and guidelines for evaluating flow meters in real-world conditions
- New methods for measuring consumption of biodiesel, methanol and synthetic fuels in maritime applications under real-world conditions
- Evaluation of commercial flow meters under static and dynamic loads, and commercial sensors for in-line density and viscosity measurements
- A validated numerical tool for analysing the interaction between a test liquid and the performance of a flow meter to facilitate improved simulations to replace costly or dangerous experimental setups
- Contributions to the EURAMET Technical Committee for Flow (TC-F) and the BIPM CCM Working Group on Fluid Flow (CCM-WGFF)



EMPIR EURAMET

The EMPIR initiative is co-funded by the European Union's Horizon 2020 research and innovation programme and the EMPIR Participating States

www.euramet.org/project-20IND13

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11326/1125- 20IND13