N°3 – December, 2024

NEWSLETTER

Metrology Support for Carbon Capture Utilisation and Storage

More than 2 years since we started this journey! With over 6 public reports and more to come, MetCCUS becomes the key reference for measurement solutions needed by the CCUS industry

Inside this issue

EUROPEAN PARTNERSHIP
Co-funded by the European Union
METROLOGY PARTNERSHIP
EURAMET

Project Highlights

Joint workshop EMN for Energy Gases with focus on Met4H2, BiometCAP and MetCCUS projects. Meet us at VSL, Delft, the Netherlands on **26th & 27th of March 2025**. Details and registration available soon!

Over 20 free-access news & publications on our website 😊 go to https://metccus.eu/news-and-publications/
Article Recommendation where MetCCUS is featured: IEAGHG comparative technoeconomic assessment of commercially available CO_2 conditioning technologies (link to publication)

Flow Metering

Metrology infrastructure activities are in progress with testing for surrogate fluids, testing 3" Coriolis meter and 4" turbine meter with Air, Nitrogen, natural gas and CO_2 at flows up to 400 m^3/h and up to a static pressure of 35 bar. A ultrasonic meter has also been tested at 25 bar with natural gas and CO_2. For smaller flows (intermediate flow) testing is ongoing with N_2 and CO_2 using a mass flowmeter and a laminar flow element and a PGM meter. Together with the testing for surrogate fluids also a intercomparison is ongoing between NEL, DNV and FORCE on large flows and between NEL, VSL and INRIM on intermediate flows. The data are being examined and will be reported later.

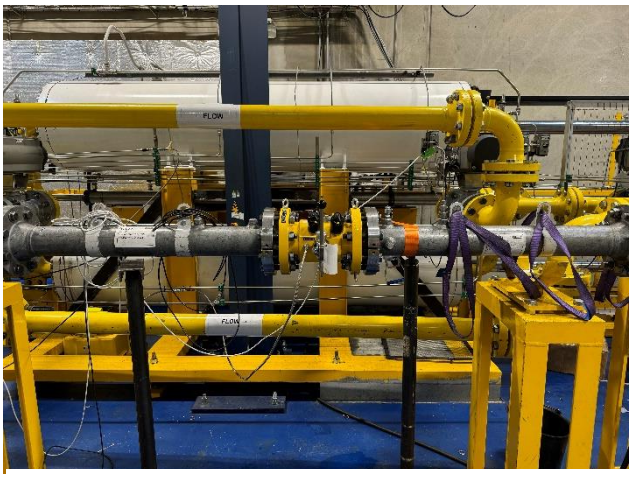

Figure 1 – Testing a turbine meter at FORCE Piston Prover

Figure 2 – Testing a Coriolis meter at FORCE Piston Prover

Emissions Monitoring

Field assessment of the use of tracer correlation to determine fugitive and diffuse CO_2 emissions.

NPL and FORCE successfully undertook a field campaign to assess the potential for the tracer correlation technique to determine site level emissions of CO_2. The field campaign utilised NPL's traceable controlled release capability, adapted to release CO_2 under this project, to create traceable known releases of CO_2. The emissions were created in a rural environment, and a range of traceable emissions from 15 to 23 kg/hr (~130 to 200 l/min) were created. Measurements were carried out over three separate release periods. NPL and FORCE both conducted mobile tracer correlation measurements using different tracer gases to assess the ability of this technique to isolate and quantify CO_2 emissions from industrial sources. The tracer correlation approach involves releasing known rates of a tracer gas at a location which is representative of the emission location. Measurements are then made of CO_2 and the tracer gas at a distance downwind. Because the release rate of the tracer is known, the ratio of the measured concentration of CO_2 and tracer can be used to determine the release rate of the CO_2. The assumption is made that the dispersion of the tracer gas is the same as for the CO_2 from the emission being monitored, and that other sources of CO_2 can be excluded. The tracer teams were aware of the general release location but not the release rates. The data are being worked up and will be reported later.

This work forms part of the experimental work to support the development of guidance on the determination of CO_2 emissions from CCUS infrastructure.

Figure 3 – NPL controlled release system being used to generate traceable emissions of CO_2

Chemical Metrology

In a significant step forward for CO_2 analysis , the project partners DTU, DNV, VTT, Air Liquide, and RISE have completed an extensive investigation into the factors affecting the performance of sampling systems used for online impurity measurements. RISE conducted long-term experiments to evaluate the compatibility of various materials with key impurities. To guide the selection of appropriate sampling bags, stability studies were performed on at least six impurities, including hydrogen sulfide, methanol, acetaldehyde, ethanol, acetone, and benzene. The finding from this study have been summarised in a detailed report [free download here]. DTU contributed additional insights by studying the performance of different sampling lines with impurities such as NH_3, HCl, and H_2O. Meanwhile, DNV focused on assessing the suitability of tubing materials for sampling NH_3 in CO_2 under high-pressure conditions (up to 40 bar). This research highlighted the critical impact of tubing materials on maintaining sample integrity and achieving reliable analysis results.

To help industry and laboratories to effectively sample CO_2 for various conditions and applications good practice guide was written [find report here].

This guide offers valuable insights and practical recommendations to support industries and researchers in achieving greater accuracy and reliability in their CO_2 analysis systems.

In parallel, VSL is hosting a comparison study to evaluate the performance of commercial instruments used for rapid impurity measurements in CO_2. These instruments will be assessed using calibration gas mixtures with varying amounts of water and oxygen in a CO_2 matrix. Key performance parameters, including response time, range, linearity, bias, and uncertainty, will be evaluated. The comparison is scheduled to take place at VSL in early 2025, marking another important step in advancing CO_2 impurity measurement technologies.

Physical Properties

Significant progress has been made on the initial task concerning the density and speed of sound measurements in CO_2+monoethanolamine at 3 different concentrations. The density measurements have been completed and the speed of sound has been completed for the first concentration. Moreover, the speed of sound in pure CO_2 was measured using an acoustic/microwave resonator at 311 K at pressures between 0.5 MPa and 1.35 MPa. These results were compared to the predictions of an updated thermodynamic model which includes acoustic relaxation effects, the results agree within 50 ppm for three selected radial acoustic modes in the frequency range between 4 kHz and 18 kHz. The apparatus was successively modified to allow for measurements with CO_2+H_2O mixtures, and a sample of purified degassed water prepared. For these measurements, the composition of the mixture will be precisely determined by the refractive index as sensed by microwave cavity modes. Selected measurements in humid mixtures will take place aiming at an estimate of the interaction carbon dioxide – water virial coefficient.

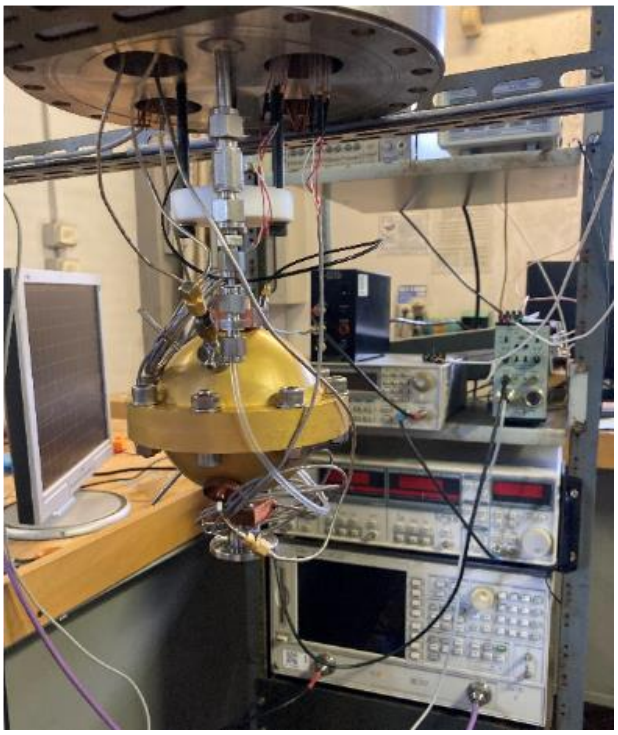

Figure 4 – Spherical acoustic/microwave resonator used at INRiM for speed of sound measurements in carbon dioxide at 311 K up to 1.35 MPa.

In other activities, existing Equations of State (EOSs) have been evaluated and the most appropriate EOS for CO_2 has been selected, matching defined capture, transport and storage conditions. Furthermore, the uncertainty of the literature data has been assessed and propagated for the relevant thermophysical properties of typical CO_2 compositions.

Finally, a new test facility to perform corrosion rate measurements in dense phase CO_2, with controlled dosing and monitoring of various impurities, has been developed and commissioned. Another new test facility is in the development phase. Validation of methods of controlling and measuring the concentration of impurities (H_2O and O_2) in dense phase CO_2 is currently in progress.

MetCCUS scientists published open-access scientific article:
"***Toward standardized measurement of CO_2 transfer in the CCS chain***"

Go to peer-reviewed paper

Other news

4th Industrial Carbon Management (ICM) Forum

The former CCUS Forum (now ICM), took place last 10th and 11th of October 2024 in Pau, France, co-hosted by the European Commission and the French Ministry. The final conclusions have now been published on the event webpage.

CEN/TC 474 CCUS WG 3 CO_2 accounting

Beginning of december 2024, the first WG3 meeting of CEN/TC 474 took place. In this group, different MetCCUS partners started drafting documentary standards for quantification and verification of CO_2 streams including flow, sampling, composition and thermodynamic properties. MetCCUS project outcomes will be used as input for these new standards.

Industry guidelines for setting the CO_2 specification in CCUS chains

In November 2024 Wood published a set of guidelines to catapult the CCUS industry forward. Work packages include thermodynamics, metering & sampling, geological storage, among others. Guidelines are available here. MetCCUS project partners participated in this joint industry project.

Recycling CO_2 emissions in Belgium

First trial of a new technology in Gent, Belgium, to convert CO_2 captured from steel production into CO, using plasma, which can then be used as a reductant in the steelmaking process. Read more here.

IEAGHG publication on MRV for CO_2

Measurement, reporting and verification (MRV) and accounting for carbon dioxide removal in the context of both project-based approaches and national greenhouse gas inventories. Read more here.

Metrology / CCUS terms of the newsletter

Carbon Dioxide Removal (CDR)	Refers to technologies, practices, and approaches that remove and durably store carbon dioxide from the atmosphere (IPCC Factsheet)
CO_2 dense phase	The CO_2 is a highly compressed fluid that demonstrates properties of both a liquid and a gas, often called supercritical fluid. Dense phase compounds have a viscosity like that of a gas but a density closer to that of a liquid, good for CO_2 transport (NPC CO_2 transport report for DOE)
Calibration	Operation that, under specified conditions, in a first step, establishes a relation between the quantity values with measurement uncertainties provided by measurement standards and corresponding indications with associated measurement uncertainties and, in a second step, uses this information to establish a relation for obtaining a measurement result from an indication (VIML) - 2022 Edition

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