

Fourth IMPRESS newsletter

Introduction

This is the fourth newsletter of the EMRP project “Metrology to underpin future regulation of industrial emissions” (IMPRESS), which aims to improve the technical possibilities to monitor emissions of pollutants to air to ensure compliance with EU directives and national legislation. This is key to enforcing emission limits and thereby enabling their reduction and control.

Industry needs to measure and report emissions for regulatory purposes including assessing stack emissions against concentration limit values, reporting annual mass emissions, and determining emissions of GHGs from area sources. In June 2014 the 3 Mio € project started within the European Metrology Research Programme for a three year period to investigate industrial emission measurements. It encompasses a multitude of national metrology institutes (NMI), universities and other stakeholders. Collaborators are welcome to link themselves to the project.

Project news

Delft University of Technology has started activities on:

- ultrasonic flow meter experiment in collaboration with VSL and Krohne
- comparison of CFD simulation of a complete test case (pipe bend) to a mixed approach development of an alternative model for an ultrasonic flow meter using Bayesian techniques and CFD to predict flow in situations where the flow rate is unknown

PTB activities on:

“Modelled deviations of gas concentrations measured by TDLAS sensor under heterogeneous conditions”

Tunable diode laser absorption spectroscopy (TDLAS), which is a line-of-sight (LOS) absorption spectroscopy technique, has become a proven method of gas diagnostics. However, LOS techniques are normally limited to flow fields with nearly homogenous conditions. The effects of thermal and pressure boundary layers on experimental data must be well understood for a successful diagnostic application. Using LOS absorption spectroscopy technique, a path-averaged concentration value can be assigned. When making concentration measurements in heterogeneous fields, the attention should always be paid to the thermal and pressure boundary layers along the absorption path, although heterogeneities might be small.

The aim of the research within the IMPRESS project is to investigate the TDLAS application in stack emission monitoring. Based on experimental test facilities in the lab, a model was developed in PTB for predicting deviations of concentration measurements) under heterogeneous conditions. For measurements with the TDLAS technique under heterogeneous temperature conditions, two regions with different temperatures in the path were set in the model. A low temperature region of 20 cm

pathlength with a temperature of T_1 , and a high temperature region of 38 cm pathlength with a temperature of T_2 were simulated. Figure 1 shows the simulated deviations using the CO transition line (R19) in the ν_2 band in the 2.3 μm wavelength region. In the simulated approach a path-averaged temperature was used to compute the concentration of the probed CO molecules. This simulated the measurement situation where the exact temperature distribution is not known and a single measured/assumed mean temperature is used to extract the measurement result. Figure 1 shows that doing so, a deviation of more than 20 % could be accumulated for the underlying boundary conditions and large temperature gradients. The deviations depend on the probed molecular transition line, i.e. its line strength's temperature dependence and the temperature level of the gas (given as T_1 in Figure 1). However, for much more realistic and smaller temperature gradients (given as ΔT in Figure 1) the deviation is staying below 5 %. Within the temperature range shown in Figure 1 ($273\text{ K} < T_1 < 418\text{ K}$, $0\text{ K} < \Delta T < 500\text{ K}$), the measured concentration by LOS TDLAS will be underestimated. Although, only a 'two step' temperature gradient is used in Figure 1, the simulation is actually capable for any temperature gradient. Simulations are powerful and more flexible than experiments due to the limitations of setups (realized heterogeneity). When monitoring stack emission by TDLAS, the heterogeneous gradients and the information of the TDLAS sensor (e.g. transition line parameters) are required to predict the deviation of concentration measurement using this simulation. The model will be improved to cope with more complex heterogeneities.

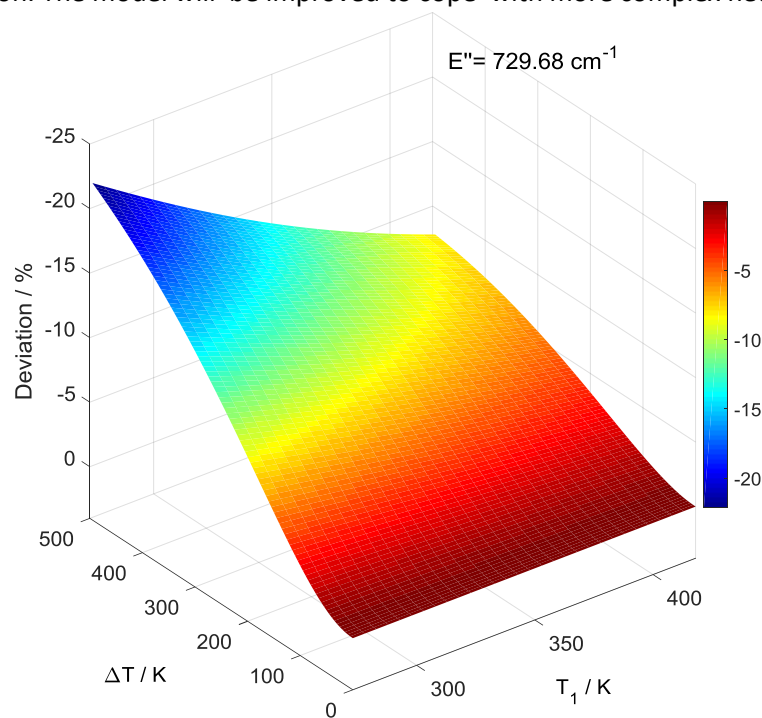


Figure 1. The deviation of concentration measurement with TDLAS at heterogeneous conditions, $\Delta T = T_2 - T_1$

Standardisation activities

Recently the IMPRESS project has contributed to the following CEN working group activities by providing funding for convenorship and / or leadership of various sub-tasks:

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EMRP
European Metrology Research Programme
Programme of EURAMET



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- CEN TC264 / WG36 Measurement of stack gas emissions using FTIR instruments
- CEN / TC264 / WG38 Determination of fugitive VOC emission

Dissemination activities

Recently work under IMPRESS has been disseminated at the following fora:

CEM2016, 12th International Conference and Exhibition on Emissions Monitoring, Lisbon, Portugal, 18th – 20th May 2016

- *Monte-Carlo model of a gas analyser operating under EN 14181:2014 to investigate achievable uncertainty during emission monitoring*
- *The development and validation of standard methods for measuring fugitive emissions*
- *Differential absorption LIDAR (DIAL) measurements of landfill methane emissions*

SIAM conference for uncertainty quantification, Lausanne, Switzerland, 4th - 8th April 2016

Contact and further information

Every 6 months a newsletter of the project will be distributed. Please forward this newsletter to your colleagues. They can send an email to any of the project's representatives with subject "register IMPRESS newsletter" to register for this 6-monthly newsletter.

Additional information on IMPRESS and the partners can be found on the project homepage <http://projects.npl.co.uk/impres/>.

The IMPRESS project is carried out by the following partners / institutions:

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