FINNISH ILCS FOR EMISSION MEASUREMENTS- SOME OBSERVATIONS ON MEASUREMENT UNCERTAINTIES

Introduction

VTT Technical Research Centre of Finland has organized interlaboratory comparisons (ILCs) measurement campaigns for Finnish stack testing teams since 1980´s. The frequency of these campaigns has typically been 4–5 years. The aim of these intercomparisons has been to evaluate the performance of participating laboratories and to identify if some corrective actions are needed in their performance. In addition to this, these measurement campaigns have provided efficient platform for the dissemination of the knowledge (e.g about new procedures, requirements) in Finland.

Participation in the interlaboratory comparison (ILC) measurements for emissions is not required on European level. In Europe, the emission measurement laboratories must usually have an accreditation according to the ISO/IEC 17025 as the accredited testing laboratory (or they must be approved by competent authority). It is a general requirement for accreditation according to ISO/IEC 17025 that accredited teams take part regularly to ILCs. And, there are also specific requirements for this in some European countries.

There are currently different approaches available for ILCs in Europe. Some countries use synthetic gas mixtures which are made by spiking different gas compositions into the test bench facility (Coleman et al. 2015, 2019, Cordes et al.2015), whereas others use gas matrices which are produced for example with boilers (Ineris ILC Schemes). When the gas matrix is prepared with spiking, the metrological value with known uncertainty can be used as the assigned value. And, if controlled testing rigs are used, then it is possible e.g to vary the concentrations for interfering components for a wide range. When the measurements are performed from real stack gas matrices, then the metrological value cannot usually be used; instead a consensus value between participants is used. On the other hand, when using real stacks, all possible interfering factors are included in the evaluation, meaning for example moisture of the flue gas, temperature, possible interfering components, difficult measurement circumstances (e.g hot/cold environmental conditions). All these approaches have their pros and cons and a mix of the two is important.

Reported measurement uncertainties during ILC organized in year 2019

Finnish ILCs have been organized in real stacks. Previous Finnish ILCs were organised in May 2019 at the waste to energy plant. During this campaign all pollutants which are required to be measured by Waste Incineration Directive were measured (NOx, SO2, CO, HCl, HF, TVOC, particles, heavy metals and PCDD/F), as well as temperature, flue gas velocity, oxygen and moisture by accredited Finnish stack testing teams. The results and observations can be found in the final report (in Finnish, Pellikka et al, 2020).

Table 1. Measurement uncertainties (95 % confidence level, k=2) reported by stack testing teams (A-H) for gaseous components, ILC organized at waste to energy plant, year 2019, Finland.

	A	B	C	E	F[2]	G[2]	H
	±%	±%	±%	±%	±%	±%	±%
NOx	12	6	6	20	3,3	7,9	7
SO_2	12	>100	87	30	22	168	7
H_2O	9	4	4[2]	10	9	6	-
O_2	9	4	5	2,4[1]	2,5	8,3	7
CO_2	12	7	3	1,9[1]	9,5	4,8	7
CO	12	31	68	10	84	10	7
HCl	20[3]	-	26	-	*	*	-
HF	*	-	26	-	*	*	-
TVOC	-	>100	17	-	40	100	8

Measured concentrations were very low typically for all components. Stack testing teams were asked the report also the measurement uncertainties, later on referred as MU. In Table 1, reported MUs for gaseous components are given.

1) stack testing team has given MU as "standard value" and it has been calculated here as relative uncertainty in order to make it comparable with other teams

2) stack testing team has reported their MUs as absolute values and they were calculated here as relative uncertainties in order to make them comparable with other teams

3) measurement uncertainty does not include the measurement uncertainty of the analysis

* measurement uncertainty was not reported since the result was < LOQ

\- stack testing team did not measure this pollutant

As it can be seen from Table 1, MUs vary a lot between different stack testing teams.

Observations

Directive 2010/75/EU of the European Parliament and the Council on industrial emissions (the Industrial Emissions Directive or IED) is the main EU instrument regulating pollutant emissions from industrial installations. At the moment, IED is just being evaluated and one of the topics that has been flagged in the survey (IED evaluation report, March 2020) are measurement uncertainties and how they are taken into account in compliance assessment. It is mentioned in this summary report that "there is some variability across the EU which can lead to quite significant differences in implementation and compliance with permit conditions". As a consequence, it is important to define on European level how to take MUs into account in compliance assessment (should they be added to the measured value, subtracted or totally ignored). This is even more significant as the concentrations decrease. (For example, in Euramet funded Heroes project, one of its aims is to characterise new uncertainty sources that become significant at low HCl- concentrations).

In addition to harmonized approaches how MU should be used in compliance assessment, we want to emphasize the importance of having pragmatic and concrete rules and guidance how MU is calculated and what are realistic maximum values for them. European standardization organization CEN and its technical committee TC264 Air quality has an important role in this case since CEN/TC264 and its working groups write standards for emission measurements (among other topics). These EN-standards are used as "tools" in compliance assessment when plant owners show to local authorities that their emissions are below set emission limit values (ELVs).

Many TC 264 measurement standards have been written and validated at the time when emissions were on higher level and now, with lower ELVs, we must have new validation tests in order to find out what are realistic MUs for these methods. Therefore, it is important that, both at national and at European level, enough support is given to standardisation work. The work of national experts giving their input to the standardization is typically funded by the Member States themselves. Now, funding for the validation of the standards at low concentration levels is an important, and critical, prerequisite so that standards and their performance characteristics can be revised for low concentration levels. The overall aim is to ensure that even with low emission levels, the emission measurement results are transparent and robust throughout the EU.

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