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Atmospheric Measurement Techniques Discussions

Interactive comment on "Influence of environmental humidity on measurements of benzene in ambient air by transportable GC-PID" *by* Cristina Romero-Trigueros et al.

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Response to Reviewer #2

General Comments

The manuscript provides the influence of ambient humidity on benzene measurements carried out with an automated in situ GC-PID that is the instrument usually used in air quality monitoring networks. I consider that is an interesting study and therefore, I recommend the manuscript for publication in Atmospheric Measurement Techniques. Some specific comments are given below to be clarified by authors before publication.

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Discussion paper

Thank you for this and your valuable suggestions.

Specific Comments

Pag. 2 27. What is the brand, model of the dynamic dilution system? Please include in the text.

Our dynamic dilution system was built in-house. This will be clarified in the text. All the description in the text regarding the humidifier, the flow rate and temperature control refers to this in-house built system. Some of its parts (such as the humidifier) were designed by the authors and some of them were bought (such as the mass flow controllers).

Pag. 3, line 18. Is the mixture benzene in nitrogen a SRM, if so please indicate it. Who is the supplier of the gas cylinder? Which is the purity? Please, indicate it in the text.

The mixture of benzene in nitrogen was provided by Abelló Linde. Its concentration was certified by Linde according to the Standard ISO 6141:2007. The expanded uncertainty of the amount fraction of benzene in the mixture was 5%. This information will be added to the manuscript.

Are the flow meters calibrated periodically? How?

The mass flow controllers are at least annually calibrated against a Gilian Gilibrator (a NIOSH primary standard air flow calibrator) available in our lab. If the deviation of the MFC measurements is higher than 1% then the measurements are corrected with a calibration line. If lower, this bias is accepted and accounted for in the uncertainty assessment of the concentration of the gas mixtures.

Pag. 4, line 10. Authors refer to Standard EN 14662-3:2005 in order to calculate the coefficient brh to see the influence of relative humidity but this standard is already cancelled and the equation 2 does not appear in the EN 14662-3:2015. Why do authors think that this equation has been removed from the updated Standard?

We think that tests were likely changed because of the non-conformities of analysers with the Standard criterion for the span concentration. It is true that the span concentration (40 μg/m3) is quite high and such high levels are not usually found in the ambient air if measured away from the emission sources. However, from our point of view, it is interesting to test other concentrations apart from the limit value. From our perspective, testing this influence with a value in between the annual limit and the span (around 20 μg/m3) would be interesting to detect important biases at high benzene amount fractions, which can be present, for instance, in industrial areas.

If the relative humidity is so important at high concentration of benzene as demonstrated in the manuscript, why it has been deleted?

I am afraid we cannot answer this question. We guess that manufacturers may have been having issues with passing this test and, arguing that ambient concentrations of benzene are not usually as high as 40 μg/m3, they may have put pressure on normalizers to soften the performance criterion.

Table 1. if (0.01) is the standard deviation, please indicate it in the table.

It is the standard deviation. This information will be added in Table 1.

Table 3 . A "("should be before μg/m3) in Cmeas. What is qt? in the text are defined qz and qH2O but not qt.

qt is the total flow rate, that is, the sum of qz, qH2O and the flow rate from the reference gas mixture. This will be specified in the caption of Table 3.

On the other hand, have the authors checked the memory effect when using high concentration of benzene (40 ug/m3)?

Indeed, we did. We followed standard EN 14662-3:2006 for this test (standard EN 14662-3:2016 does not substantially change this test). We measured a nominal concentration of benzene in air of 45 μg/m3 and then we switched to zero air. We carried out this test for Analyser I and II. For Analyser I we obtained the following 3 sequen-

tial measurement results: 46.59 μg/m3, -0.01 μg/m3 and -0.01 μg/m3. For Analyser II we obtained: 45.05 μg/m3, 0.32 μg/m3 and 0.31 μg/m3. Both analysers met the performance criteria of the Standard for this test (a measurement < 20% of the annual limit value for analysis n.2 (the one right after changing the concentration to zero) and <10% of the annual limit value for analysis n.3). Analyser II measured 0.05 μg/m3 in a fourth analysis and 0.01 μg/m3 in a fifth one, so we can conclude that this effect is not significant in this type of instruments. In any case, every time we changed the concentration of benzene we excluded the first measurement from the data analysis.

Technical comments

Pag. 1, line 25: revise “h0ematologic”

Thanks for spotting this.

Pag. 1 , line 29. Reference properly the Standard EN in reference section. The standard number is missing.

We will add the number of the standard in the text.

Pag. 4. , line 7 and pag. 5, line 4. I think that authors should change “2005” by “2015”.

We will explain that the tests were carried out according to Standard EN 14662-3:2005 as these were carried out before the publication of the new standard. We will also describe the differences between the two standards regarding the humidity influence.

Pag. 4, line 18. Section 2.2.2.1 should be 2.2.2.2

Thanks for spotting this.

Pag. 5, line 6. Revise the sentence: Moreover, coefficient. . .. In air.

This sentence has been reworded to “Moreover, calculated coefficients brh for both analysers turned out to be higher than 4% (the maximum variation allowed in the Standard EN 14662-3:2005) when the tests were carried out with 40 μg/m3 of benzene in

air". This will be accordingly changed in the manuscript.

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