

Interactive comment on “Characterization and testing of a new environmental chamber designed for emission aging studies” by A. Leskinen et al.

Anonymous Referee #1

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The manuscript describes and characterises a new photochemical aerosol chamber at the University of Eastern Finland. The subject and content of the manuscript is suitable for AMT, and should serve as a reference for future research at the reported facility. I believe the manuscript has the potential to be accepted for publication, but not before the authors address the following concerns and comments.

Major Comments:

Title: Although the title clearly states that the chamber is designed for emission aging studies, it does not provide any proof of concept evidence to show successful coupling of any type of emission sources to the chamber. What the manuscript presents is a description and characterisation of an environmental chamber. The title must be changed

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to remove any reference to emission studies unless the authors provide details on such studies. The fact that it is located within the ILMARI facility is not enough to justify the title.

Page 5932, line 5-8: It is not clear how the wall loss calculations were applied. The results in figure 2 and 3 emphasise the importance of size dependant chamber wall losses, therefore the authors should explain whether they have applied details size dependant loss corrections or have only used the polydisperse correction. It is clear from the reported results that the former should have been applied. In either case, this should be explained and discussed. The authors should also mention whether or not any attempts have been made to quantify, and correct for, the gas phase loss of the precursor.

Pages 5933-5934, section 3.2: I presume that the Kuopio data is for the irradiance integrated across the whole wavelength range, not over the comparable range of the black lights <400nm? This needs to be clarified and stated in the manuscript. It surely has an implication on the chemistry. A wider discussion of the implication of the missing radiation at all wavelengths >400nm is required. More importantly, I am surprised that the employed backlights appear to be missing an atmospherically important part of the light spectrum between 300–340nm. This is critical for the production of OH from ozone photolysis and also important for the photolysis of other atmospherically relevant VOCs. The authors need to clarify their choice of this specific type of light and discuss the implication on the photochemistry and aerosol yield.

Page 5935-5936: The discussion of yield values under seeded and un-seeded conditions is inconsistent. The reference to the rate constant in equation 2 is confusing as I don't see how is affected by light intensity. I presume the authors meant to refer the difference in light intensity and its effect on yield rather than the NO/O₃ reaction rate. This should be clarified. In addition, the reference to gas phase wall losses being more intense in the absence of seed particles (i.e. the authors data) should lead to lower yield, which is the opposite of what is being reported. I believe that the concept

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of yield, despite being widely used in the literature, is misleading and hard to quantify due to differences between chambers and in the way researchers apply wall loss corrections for particle mass and to an almost always absent characterisation of the tricky gas phase losses. Those are a few of the issues that make a yield value chamber specific, which is hard to directly compare to other chambers given the uncertainty associated with gas and particle phase wall loss corrections and the wide differences in light and oxidant characteristics across chambers. The authors have indeed made a brief mention of the difficulty of comparing yield values from different chambers, but they only did so in the conclusion without elaborating on this in the main discussion. This needs to be addressed. Additionally, in order to establish the effect of seed on the yield values, the authors should ideally report their own seeded experiments yield values and compare to them.

Other Comments:

Page 5923, line 23: Black lights are only one type of lights used in chamber. This should be changed to "artificial" lights so it is more inclusive.

Page 5926, line 25: Is this aluminium plate exposed to the inside of the chamber or is it covered by Teflon. This should be clarified.

Page 5930, line 26-28: What is the injection efficiency of this method? Would it be suitable for other VOCs over a range of volatilities? Have the authors considered using a gently heated glass bulb for this purpose?

Page 5934, section 3.3: The discussion of the temperature control means that the chamber is currently only operational with half of its lighting capacity at most. This implies that the characterisation results presented in the manuscript are currently partly not representative of the operational conditions of the chamber. The plan to upgrade the air conditioning unit which is mentioned at the end of the conclusion section should be clearly stated in the main body of the text to ensure that the reported characterisation are in agreement with the facility actual capabilities.

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Page 5749: The quality of Figure 5 is poor. The display should be expanded across the time axis to allow better visualisation of the data.

Page 5750: The quality of the Figure 6 is extremely poor. The display should be improved.

Page 5751: The authors should comment on the unexplained step changes in the data of the green trace (m/z 99) around 150 and 240min. The data during this period is inconsistent with the rest of the data in the figure.

Minor Corrections:

Abstract, line 3-4: change "belongs to" to "is part of" Abstract, line 6: "are side by side" should be "are located side by side" Page 5922, line 24: Remove "The" from the start of this sentence. Page 5923, line 1-2: change "during the aging" to "during aging" Page 5923, line 5: delete "the" Page 5924, line 4-5: should be "vegetation, stacks or tailpipes", also "the emission sources" should be "emission sources". The article "the" is used far too many times at in-appropriate places throughout the introduction. This needs to be checked and corrected. Page 5924, line 21-22: the phrase "and hopefully can help persons when planning new chambers in their work" should be deleted. Page 5927, line 9: "Ammoniumsulphate" should be changed to "Ammonium sulphate" Page 5934, line 14: Change "nor" to "not" Page 5937, line 25: change "air conditioner" to "air conditioning unit"

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