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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Role of methyl group number on SOA formation from aromatic hydrocarbons photooxidation under low NO_x conditions" *by* L. Li et al.

Anonymous Referee #2

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General Comments:

This paper presents a significant set of experimental data for SOA formation from benzene and substituted benzenes. It considers the influence of the number of methyl groups on SOA yield, composition, and related parameters. Results are put in the context of previous work in the field. Conclusions and analysis are generally sound, but some of the writing and presentation needs additional clarification as noted in the comments below. I recommend the manuscript be published after the comments are addressed.

Specific Comments:

1-page 31153, In title and in many places throughout article it would be more accurate to say “monocyclic aromatic hydrocarbons” instead of the more general “aromatic hydrocarbons” to make clear that the focus of this study was benzene and substituted benzene compounds.

2-page 31154, line 2, The wording “determines the SOA formation” is unclear. Does it refer to SOA yield? composition? Both?

3-page 31154, line 16, Unclear what is meant by “less oxidized per mass/carbon.”

4-page 31155, line 13, Define what is meant by “methyl group branching”

5-page 31158, line 14, How are the yield values found in this study different from those in previous studies? Higher or lower?

6-page 31158, line 17, How much higher are the current benzene SOA yields compared to the cited studies?

7-page 31159, line 11, Change “suppresses SOA formation” to “suppresses formation of lower volatility products”

8-page 31159, lines 12-14, The claim in this sentence has not yet been supported. Perhaps change “indicates” to “suggests”

9-page 31159, lines 25-26, Possibility (3) seems to be just an observation of behavior, not an explanation for the methyl group effect.

10-page 31159, line 29, SOA yields at what point in the experiment? Yield varies with time/Mo/deltaHC so it is important to specify what yield values are being used for the correlation.

11-page 31160, line 2, OH is the only parameter with a statistically significant correlation ($p<0.05$). The strength of correlation values for all the other parameters are meaningless since the relationships aren’t statistically significant.

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12-page 31160, line 15, Add a sentence explaining what f44 and f43 represent relative to degree of oxidation.

13-page 31160, line25, Explain what is meant by “evolution trend”. Also, tetramethylbenzene seems to shift too.

14-page 31161, line 1, Here and throughout the article it refers to general trends of parameters increasing or decreasing with the number of methyl groups. It would be helpful to make clear that it is not a uniform or consistent trend. For example, in Figure 2 the number of methyl groups is in the order 0,1,2,3,5,4,6, while in Figure 3a it is 0,1,3,2,4,6,5.

15-page 31162, line 11, What is the “elemental ratio evolution trend” and how does it agree with the f44 vs f43 trend? 16-page 31164, line 16, Only m-xylene results are reported. Would there be differences for the other xylenes (o-xylene, p-xylene)? Similarly for the tri- and tetra- methylbenzenes.

17-page 31164, line 23, Pentamethylbenzene also shows a significant overestimation and should be mentioned.

18-page 31166, line 14, Density underestimation doesn’t seem to “enlarges with increasing methyl group”, but appears about the same for 2,3,4,5 methyl groups. And should also mention, and possibly discuss, the overprediction for benzene and toluene.

19-page 31172, line 6, Change “A decreasing trend” to “A generally decreasing trend”

20-page 31172,line 10, Clarify what is meant by “aromatic aging”. Aging can refer to many different changes. The statement would be correct if it defines aging as transformation to less volatile compounds.

21-page 31172, lines 15-16, Are benzene and toluene always the most important precursors of those studied here? Or is it just under low NOx conditions?

22-page 31172, lines 17-19, Hexamethylbenzene is not the only compound with a

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discrepancy between predicted and measured oxidation, calling into question the claim of uniqueness. Both m-xylene and pentamethylbenzene are much less oxidized than predicted.

Technical Corrections:

23-page 31158, line 7, Should “(Table 2)” read “(Table S2)”?

24-page 31164, lines 14-15, add “_SOA” to subscripts for “O/Cpre,i” and “H/Cpre,i” to make clear it is the elemental ratio of SOA, not of the precursor.

25-page 31165, line 7, The R2 correlation values listed in the text seem too high for the data shown in Figure S3.

26-page 31167, line 8, Define VFR the first time the acronym is used.

27-page 31168, lines 4-5, Correlation coefficients and p-values listed in the text are not the same as those in Table S5.

28-pages 31190-31191, The coloring in Figures 2 and 3 that corresponds to the number of methyl groups would be much more useful if it was consistent. In Figure 2 and Figure 3a the colors for 0/1/2/3/4/5/6 methyl groups appears to be red/yellow/green/light blue/dark blue/orange/gray (but with purple dots for 5 and 6). In Figure 3b, however, the colors are red/orange/green/green/light blue/dark blue/purple.

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