

## ***Interactive comment on “Effect of salt seed particle surface area, composition and phase on secondary organic aerosol mass yields in oxidation flow reactors” by Erik Ahlberg et al.***

### **Anonymous Referee #1**

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Ahlberg et al. presented a study that examined the effect of seed aerosol surface area, composition and phase on SOA mass yield in an oxidation flow reactor. This paper is potentially useful to the SOA community. However, there are portions of the manuscripts that are vague and confusing, and they need to be addressed before the manuscript can be considered for publication.

Specific comments:

1. Page 3 line 26: Why was a mixture of VOCs instead of pure  $\alpha$ -pinene or pure m-xylene used in these experiments? Won't modeling condensational sinks be easier if single-component VOCs were used in the experiments? Different LVOCs will be lost

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to the reactor's walls at different rates. Hence, the condensation sinks, extent of yield under-estimation etc. discussed in this manuscript are really some average of the  $\alpha$ -pinene and m-xylene SOA systems. There is no way to determine which SOA system is the main cause of this yield under-estimation.

2. Page 3 line 29: Related to the previous comment, were the  $\alpha$ -pinene and m-xylene present in equal quantities in the mixture used? The authors mentioned that the evaporation rate of the mixture decreased over time. Did the evaporation rates of  $\alpha$ -pinene and m-xylene decrease at the same rates?

3. Page 4 line 11: I suggest that the authors define "OH reactivity" here (instead of a few lines further down) in order for their sentence to be less confusing.

4. Page 4 line 21: "from a few to 10 % on a mass basis..." it would be use to provide a number instead of using the term "a few".

5. Page 4 line 30: Please provide the reasoning behind drying the aerosols before measurements by the SMPS and AMS.

6. Page 6 line 11: How do the authors know that 100 % of the input VOCs will react in the flow reactor? VOC measurements? Modeling? It is worth explaining in the paper even though knowing the exact concentration of reacted VOC is likely not essential to the authors' comparison of relative increase in mass yields.

7. Page 6 line 17: The discussion on the mass yield uncertainties is confusing. What do the authors mean by "However, this may give a too small range"? Also, what do the authors mean by "No experiment was repeated fully"? I thought the authors replicated their experiments. Also, what do the authors mean by "..., but single point replicates gave a fractional error of 14 % compared to expected values"? What do these "expected values" refer to? In general, I highly recommend that the authors revise this discussion on mass yield uncertainties.

8. Page 6 line 24: The authors used the expression "error in the yields of these exper-

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iments". This use of this expression feels inappropriate since it gives readers an initial impression that errors were made in the calculation of the yields, which is not the intention of the authors. I suggest using the expression "extent of yield under-estimation" instead.

9. Page 6 line 27: What do the authors mean by "the produced organic sink"?

10. Page 6 line 28: How was the condensation sink calculated?

11. Page 6 line 31: The authors stated "This could be due to increased particle losses in the reactor...". Is this explanation valid given that the authors stated that particle losses are small in section 2?

12. Fig 4: The y-axis is given as "Yield/Max yield" while the main text states that the y-axis is Yield increase/Max yield increase. Which is the correct y axis label?

13. Page 7 line 16: The authors stated "At 10 ug/m<sup>3</sup>, the increase in yield is estimated from the linear regression between data points in Fig. 5...". This sentence is confusing. Which data points are the authors referring to? Do the authors fit all the data points for each VOC or only a subset of points near 10 ug/m<sup>3</sup> OA? Why was linear regression used? Perhaps a non-logarithmic version of Fig. 5 should be provided because the current figure looks like it is better fitted to an exponential function.

14. Page 7 line 20: What do the authors mean by "a higher VOC produces a sink faster than a low input"? Are they referring to the condensation sink rate? Also, won't a higher VOC input result in higher concentrations of LVOC, some of which will be lost to the reactor's walls? Also, previous environmental chamber studies have shown that the use of different VOC concentrations may result in different peroxy radical chemistry and hence different SOA mass yields. Did the authors consider this possibility in their flow reactor study?

15. Page 8 line 22: Do the authors mean "SOA mass fraction per particle"?

16. Page 8 line 25: Kroll and co-authors studied the heterogeneous OH photooxidation

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of low-volatile organic aerosols such as squalane, oleic acid, linoleic acid etc., not SOA. Please make the appropriate revisions.

17. Have the authors looked at how the oxidation state changes as a function of SOA mass concentration? This analysis may provide some insights into the possibility that particle-phase chemistry may be the reason for the increase in O/C with SOA mass concentration.

18. Although this is likely the first study that examine the effect of seed aerosols on SOA formation in a flow reactor, the effect of seed aerosols on SOA formation in chamber experiments has been studied by Huang et al. (JGR: Atmospheres, 2016). In that study, the authors performed PMF analysis on their data to determine that differences in particle-phase chemistry contributed to the differences in SOA mass yields when different seed aerosols were used in a-pinene ozonolysis experiments. Perhaps the authors can perform similar PMF analysis to their data to explain their results in this flow reactor study.

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