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Atmospheric Measurement Techniques Discussions

Interactive comment on "Design and Characterization of a new OFR: The Particle Formation Accelerator (PFA)" *by* Ningjin Xu and Don R. Collins

Anonymous Referee #3

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Xu and Collins presented a comprehensive study of a newly designed flow reactor, the particle formation accelerator (PFA), the basic idea of which is from the oxidation flow reactor (OFR). Different from the commercialized OFR, the PFA is made of PFA-Teflon and vertically oriented, thus having different effects on potential losses of both vapor molecules and particles as well as the fluid dynamics inside. The authors characterized the residence time distributions (RTD), transmission efficiencies, yields, and aerosol forming enhancement of the PFA. The manuscript is overall well written and the introduction of the PFA will be of interest to the OFR community. It fits the scope of AMT and should be accepted for publication after considering the following minor revisions:

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Discussion paper

1. I think in the Introduction part it is worth mentioning that the PFA is vertically oriented and the heating source is on the top, thus minimizing the convection and maintaining laminar flow profile, which is different from other oxidation flow reactors.

2. Section 2.1 is a little difficult to follow and it does take me a while to figure out the actual design. I think it needs to be rearranged with subsections, e.g., inlet, main tube, outlet, lamps, etc., to make it clearer.

3. Line 121: based on the parabolic flow assumption and the dimension (2.1 cm ID of the cone and 7.8 cm ID of the tube), it is just about 14% flow that goes into the cone ideally. That 50% flow is extracted at the cone suggests that it is not the parabolic profile at the outlet. Maybe clarify this point here.

4. About the lamp: if I understand correctly, the lamp is exposed directly to the flow? Also, since Sections 2.6 & 3.2 presented the experimental measurement of light intensity as a function of the distance to the bottom, it is worth mentioning it in Section 2.1 at least or rearranging the two sections.

5. About the position of ePTFE: is it inside the PFA tube or outside the PFA tube but inside the layer of aluminized Mylar?

6. Line 142: it is not very clear how the two U-bolts hold the tube inside the aluminum tube.

7. Line 148: is the temperature referring to the gas coming out of the PFA tube or that coming between the shell?

8. About the experimental setup: how is the gas getting through the tube, by pulling due to vacuum at the outlet or pushing at the inlet? For each case, there should be an excess flow (or open port), but Fig. 2 cannot tell. I guess it is pulled by the vacuum at the outlet?

9. About purge flow: does this flow determine the actual flow fraction that goes into the outlet cone?

10. About the charge effect on particle wall loss: does it have a preference on a specific polarity when there is a static charge on the surface?

11. Line 221: how is the gas transmission efficiency determined by pulse injection? Does the concentration downstream refer to integrated concentration?

12. Section 3.1: same as comment 3, how does the simulated velocity distribution look like at the outlet w/ and w/o purge flow?

13. Figures 5 & 6 show that even with the high-reflective layer, the UV intensity at the inlet can be one-third of that at the outlet and the corresponding OH concentrations could be the same ratio. Thus there could exist a transition regime in the reactor that a compound reacts with O_3 and OH equally. Though it does not affect the OH exposure calculation, knowing the distributions of O_3 and OH along the tube will be helpful to analyze the competing reaction channels. If this point is out of the scope of this manuscript, it is worth mentioning that point though.

14. For the transmission efficiency of sticky vapor molecules, I am wondering if the transmission efficiency increases as the Teflon wall gets saturated after absorption/adsorption for a long time? The same question goes to Section 3.5, will the SOA yield increase after the experiment runs for a long time when the Teflon wall gets saturated with the sticky vapor molecules? For experiments with seeds, what is the timescale loss to the wall versus that to the particle surfaces?

15. Equation 3: since RTD is the term used in the context, PDF may be replaced with RTD.

16. Line 324: what is the purpose of turning off the purge flow?

17. Lines 351 and 360: it is worth noting here that the reactivities of OH and VOC are different.

18. Line 384: How is the ambient OHR determined?

19. Figure 10: For experiments under the same condition, how are the different data points from since the flow reactor is usually running at a steady-state? If it is because of different injected VOC concentrations, it is better to mention that in the caption.

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