

Interactive comment on “Gasoline aromatic: a critical determinant of urban secondary organic aerosol formation” by Jianfei Peng et al.

Anonymous Referee #2

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The paper by Peng et al. summarizes results of experiments on SOA formation in a smog chamber from exhaust of a PFI gasoline vehicle and two gasoline engines (PFI and GDI), running on fuel with different PAH contents. The results indicate significant SOA formation that is not reproduced by taking into account SOA formation yields and the measured single-ring aromatics; underestimation was more so with fuels of higher PAH content. The authors conclude that PAH components of gasoline are important contributors to urban SOA and their emission control can benefit local air quality. The paper can benefit from a thorough edit as some sentences/words are not structured properly. The topic of the manuscript is of high interest in the community, but there's a major shortcoming (see my first comment below). Other comments are also highlighted. Specific comments: - One major shortcoming of the paper is

C1

the limited characterization of gas phase SOA precursors (both alkanes and higher molecular weight PAHs). The authors should address this in the discussion of results to convince the readers that the increased SOA is truly from PAHs and not other, un-specified species. - Line 68: what is meant by “strong oxidizability condition”? Is that conditions similar to PAM? Figure 1 indicates oxidation for both types of experiments was carried out in a smog chamber. - Line 84-86: what's the effect of dilution on re-partitioning of semivolatile species? Also, what is the temperature of the exhaust in the CSV? Since transfer lines aren't heated, could temperature differences affect equilibrium partitioning of the semivolatiles. - Line 106: please indicate the olefin content for comparison (rather than having to refer to the SI table) - Was zero air added to the chamber throughout the experiment, meaning the chamber was being diluted constantly? - It is unclear how H₂O₂ photolysis leads to NO₂ formation. I believe HO₂/RO₂+NO reactions predominantly form NO₂. Please clarify. - Why was OH assumed to be 1.6e6 molecule/cm³ rather than using the calculated OH values based on the toluene/benzene? - Line 166: Was POA removed from the exhaust before introduction in the chamber? What was the mass of POA? - Line 186: the size distributions during wall loss experiments are very different from the size distribution of the actual chamber oxidation runs. Coagulation rates and losses are size dependent- how does this discrepancy affect the results? - Line 208-209: I think this conclusion is a bit out of place- just because formation of SOA from the PFI engine was high, it doesn't mean it can represent SOA production from vehicles with low after-treatment technologies. - Line 218-219: how did the total aerosol mass in between experiments compare? If total mass was comparable, at least the effect on partitioning would be similar in the experiments with different fuel types, but if not, that adds another level of variability of the results that needs to be considered. - Line 224: is EFs of PM referring to primary PM? Please clarify - Line 228: how were PAHs in the aerosol phase determined? - Line 241-242: Is addition of acetylene or ethylene to PAHs reversible? I'm still confused how the PAH content and acetylene/ethylene concentrations are related. - Alkanes are known to form SOA as well. Why aren't they considered the SOA budget of these experiments

C2

and assumed to be not important?

Figures: Fig. 2, panel 2 and Fig. 5: why are there gaps in the measurements? Fig. 3: the x-axis in both plots should be similar for comparison Fig. 3: it would be easier to read the plots if the legends appeared as legends rather than figure captions Fig. 4: why aren't values of aromatics and NMHCs from the PFI engine shown? Also, SOA-GDI and PM-PFI are not included. If the plot gets too busy, possible a table with all the values from the runs should be included. If the Is total PAH referring to the condensed phase PAH? Fig. 4: there's no need to repeat the legends symbols in the caption.

Technical comments: - Line 17: consider rephrasing as "... potentially considerable impact on ..." - Line 17-19: the second part of the sentence needs to be rephrased - Line 20: consider "... through chamber oxidation approach." - Line 22: "Considerably higher content of both monocyclic and ..." - Line 42: consider "...don't sufficiently take into account the impacts on SOA production. This deficiency is mainly attributed..." - Line 46: "...one benzene ring..." (not ring-like structure) - Line 57: "However, until..." - Line 74-76: unclear what 'different standard stage and working situation' means. - Line 93: "... with 50% load." - Line 96: unclear what 'successively' means - Line 113-114: "...around 2010 and after 2013, respectively, in ..." (I believe respectively refers to the year of F2 and F3 fuel use and not the cities?) - Line 116: remove "were conducted" - Line 128: remove 'to perform' and replace 'meanly' with "normally" and "noon" to "noon" - Line 133-132: This first sentence seems to be repeat of what has already been mentioned in the last paragraph - Line 136: "...composed of a ..." - Line 140: remove "... were continuously tracked..." - Line 150-151: dilution factors have already been discussed before, consider removing this sentence - Line 155: "approximately" - Line 160: "...in order to compare..." - Line 170: consider using HR-ToF-AMS instead of the full name - Line 177: "...highly..." - Line 179: consider replacing "oxidized" with "formed" - Line 187: please include the exposure time at the end of experiment - Line 200: please indicate what the time period for this SOA production rate is/ - Line 213: "...reproducibility..." - Line 226: unclear what 'administration' refers to - Line 229: "...

C3

from the exhaust increased by 0.2 to ..." - Line 331: "... particle-phase PAHs was amplified by 1.8...". Also mention what this comparison is against (F2 vs F3 or F1 vs F3). - Line 234: what is meant by "from one cycle to seven cycles?" - Line 235-236: This sentence is confusing - Line 240-241 "... three-way catalyst were enhanced by ..." - Line 243 "... In the exhaust was estimated by ..." - Line 257: "...even higher (up to..." - Line 264: consider adding "likely a majority..." since there are not measured - Line 269: "... High emission of single-ring aromatic VOC as well as SVOCs such as low molecular-weight PAHs." - Line 272: "... after treatment technology, operated at steady-state, suggesting the extensive applicability of our results." - Line 278: "...continuously..." - Line 279: "...sulfur content have been sent and the oil..." - Line 284: "Neglecting the side effect of fuel standard change on SOA production may potentially ..." - Line 287: "... require..." - Line 287: what is meant by 'catalytic reforming'? - Line 298: please include references for the range of PAH content of gasoline

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C4