

Interactive comment on “Gasoline direct injection vehicles exceed port fuel injection ones in both primary aerosol emission and secondary aerosol formation” by Zhuofei Du et al.

Anonymous Referee #1

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This paper reports a comparison of primary emissions and secondary organic aerosol formation from one gasoline direct injection (GDI) and one port fuel injection (PFI) gasoline vehicle. There is a limited but nonetheless useful study and interpretation of the formation of secondary organic aerosol (SOA) in relation to the low molecular weight aromatic compounds contained within the exhaust. My main concern over this paper is that previous work has shown quite substantial variations between vehicles of similar engine specification using the same fuel, and hence comparing one GDI vehicle with one PFI vehicle and then making very general statements about one technology versus another has the potential to mislead seriously. In this context, the title of the paper is most inappropriate as there is no evidence that the vehicles tested are repre-

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sentative of GDI and PFI vehicles more generally. For this reason, major modifications are recommended and the overall tenor of the paper needs to be much more subdued in relation to the comparison.

There are also issues over the way in which the technologies are described. Lines 25-26 state that “these studies show that GDI vehicles emit more primary particles than PFI vehicles, and even diesel vehicles equipped with diesel particulate filter” and lines 289-290 state that “the considerable particle number emitted by gasoline vehicles, especially in GDI vehicles exhaust. . . needs to be controlled in the future emissions standards”. This ignores the fact that the European Euro 6 regulations set a particle mass and a number emissions standard for GDI which is the same as the emissions standard for diesel vehicles and consequently GDI engines with high particle emissions are fitted with particulate filters in order to meet the emissions regulations. Such filters will remove elemental carbon and POA as well as reducing the emission of organic vapours (as they have catalytic activity), and consequently SOA production will be substantially reduced. Thus, the GDI vehicle tested in this study is almost certainly not representative of current GDI vehicles on sale in Europe (and most probably North America, although I am less familiar with that market) and for this reason also, the presentation of the results is likely to prove highly misleading.

Other points worthy of attention are the following: (a) Line 71 states that the gasoline fuel meets the China phase V fuel standard. This means nothing to the general reader. Fuel quality standards have in recent years been driven by sulphur content. As a minimum, the sulphur content of this fuel should be indicated.

(b) Line 240-241 suggests that since semi-volatile vapours may partition more strongly into the particle phase at higher aerosol concentrations, this would increase SOA formation. There are two factors here. The authors appear to be referring to the partitioning of the oxidation products which will give an increase in SOA yield at higher pre-existing particle loadings. However, there is a second effect which may be more significant. If the precursors of the SOA partition more strongly into the condensed

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phase at higher ambient particle loadings, there will be less vapour phase compound present to be oxidised and therefore the rate of SOA production will be reduced. This point needs to be considered when discussing the SOA yields on page 9.

(c) Table 2 refers to measurement of OC/EC but does not specify the analyser or the protocol. This should be included.

(d) Table 4 reports emission factors for PAH but does not specify which compounds.

There are relatively few data reported in this level of detail in the literature and consequently there will be some interest in the results from this paper. However, it requires very substantial revision to make clear that the results should not be extrapolated to all GDI and PFI vehicles and that the GDI results will not be representative of vehicles currently on sale in some other parts of the world.

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