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Atmospheric Chemistry and Physics Discussions

# *Interactive comment on* "Vehicular emission of volatile organic compounds (VOCs) from a tunnel study in Hong Kong" *by* K. F. Ho et al.

**Anonymous Referee #2**

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General comments:

The paper presents emission factors of VOCs for mixed vehicles in a tunnel within Hong Kong. In my opinion this paper contains few interesting findings and little novelty in atmospheric chemistry and physics, although the data set provides the emission factors of many categories of VOCs. Nevertheless, I think the paper is valuable for providing local emission profiles under certain circumstance (high emission factors of propane and butane related to emissions of LPG-fueled vehicles), and also helpful for estimating contributions of vehicular and non-vehicular emissions to ambient VOCs.

In the present form, the paper only gives the emission factors of VOCs for "mixed vehicles" in a tunnel. The applicability and merits of this paper could be enhanced if authors can extend their study to derive emission factors for the three major vehicle



types (diesel-, gasoline-, and LPG-fueled vehicles) in Hong Kong. With regard to ozone formation potential (OFP), the paper presents that the largest contributors to ozone production in Shing Mun Tunnel were ethene (23% of the measured VOC reactivity), propene (12%), and toluene (9%). However, no break-down knowledge was given for these compounds with high OFPs contributed from diesel-, gasoline-, or LPG-fueled vehicles. The result is of limited usefulness for estimating the degree of impact from the three major vehicle types on the environment, and thus providing little usefulness for making emission control strategies.

Perhaps, the authors could try to derive individual emission factors for LPG-fueled, gasoline-fueled and diesel-fueled vehicles from the regression equations of EFs of individual VOC species with the change of the fractions of vehicle types in Table 3 under the conditions of fair to good correlations between them. Another approach that may be worth to try is to compare the emission factors of "mixed vehicles" in the tunnel with those of different type vehicles (diesel-, gasoline-, or LPG-fueled vehicles) from chassis dynamometer tests to estimate EFs of VOCs for individual types of vehicles running on road.

Specific comments:

Page 12651 Line 10: Was sampling time "one" or "two" hours? If it was two, the pressure in the 2-l canister would exceed 1 atm. Was the canister pressurized when sampling?

Page 12651 Line 19: Emission profiles of motor cycles and private cars could be very different although they all use gasoline as fuel (Tsai et al., 2004). I think it's quite unsuitable to blend them together as the authors discuss the significance of different vehicle types to VOC emissions.

Page 12651 Line 20: Did all the light goods vehicles fueled by diesel in 2003 in Hong Kong?

Page 12656 Section 3.3: m,p-Xylene/ethylbenzene in different areas can be quite different. The authors can compare the ratio inside the tunnel with that outside the tunnel or in other nearby areas in HK to prove that VOCs inside the tunnel go through little photochemical processing. For the purpose stated in line 19-24 of page 12656, it's not suitable to compare with other far away areas, or even with other countries. In addition, propane/ethane is unsuitable to be employed for this purpose because of their relatively long lifetimes (around 40 days for ethane and 10 days for propane) and different emission sources.

Page 12657 Line 23: It's surprising that the correlation between isoprene and CO was poor in the tunnel, and the concentration of isoprene at the tunnel outlet was lower than the tunnel inlet in this study. It's very different from many other studies of anthropogenic isoprene sources (Reimann et al., 2000; Borbon et al., 2001; Barletta et al., 2002). The authors need to explain the possible causes for this.

Page 12658 Line 1-6: n-Pentane, i-pentane, 2,3-dimethylbutane, 2-methylpentane and toluene are also from exhaust of gasoline-fueled vehicles. Why is that the good correlations of these species can indicate the importance of running evaporative loss from gasoline-fueled vehicles? Moreover, n-nonane, n-decane and 1,2,4-trimethylbenzene are also emitted in part from gasoline-fueled vehicles. It could be just that the good correlation of most species from different type vehicles simply means that air in the tunnel was well mixed.

Page 12659 Line 23: Toluene and i-pentane are also from unburned gasoline in vehicular exhaust. Why are these two gases appropriate as tracers of gasoline evaporation in the tunnel? Additionally, in line 23-25, "their enhanced concentrations" compared with "what" to indicate the importance of running evaporative loss from gasoline-fueled vehicles?

Page 12660 Line 20: "ethane" should be "ethene"

Page 12660 Line 23-25: "The unsaturated hydrocarbons contribute most to the po-



tential ozone formation, at 56% but contribute to only 32% of ozone formation" This statement is confusing and needs to be rewritten.

Page 12660 Table 1: It would be better to show the standard deviation of traffic composition of Shing Mun Tunnel. Motorcycle and private car should be separated if their emission profiles were very different.

Reference:

Reimann, S., Calanca, P., Hofer, P., 2000. The anthropogenic contribution to isoprene concentrations in a rural atmosphere. Atmospheric Environment 34, 109-115.

Tsai, J. H., Hsu, Y. C., Yang, J. Y., 2004. The relationship between volatile organic profiles and emission sources in ozone episode regionâĂŤa case study in Southern Taiwan. Science of the Total Environment 328, 131–142.

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