



## **Volatile organic compounds inside urban tunnels of São Paulo City, Brazil**

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Volatile organic compounds, such as oxygenated hydrocarbons, aliphatic and aromatic hydrocarbons were measured in ambient air from two distinct urban tunnels in São Paulo City, Brazil, in special, at rush hours. In these tunnels, traffic jams with significant numbers of vehicles with inadequate emission controls are frequent. São Paulo, a highly polluted city, has an unconventional mix of vehicle types in that a variety of gasoline blends, including oxygenated ones are used. Inside and outside tunnel measurements were performed to evaluate pollutant levels originated from direct vehicular emissions and formed by atmospheric photochemistry. Formaldehyde/acetaldehyde ratios of tunnel (A) circulating only light-duty vehicles fueled mainly with gasohol, a mixture containing 78-80% (v/v) gasoline and 20-25% ethanol, were  $< 1$ ; ratios of tunnel (B) circulating light-duty vehicles fueled mainly with gasohol and heavy diesel vehicles, were approximately equal to 1. Formic acid/acetic acid ratios of both tunnels were much lower than 1. Benzaldehyde was suggested as a possible tracer of light-duty gasohol vehicular emissions. *N*-alkanes were the most abundant compound class (similar levels in both tunnels) followed by carbonyl compounds (higher levels in B), and aromatics compounds (higher levels in A). Organic acids, the minor species, were found at similar levels in both tunnels. Results of this survey show that toxic pollutants are present at significant levels in both tunnels. Formaldehyde and benzene, human carcinogenic agents, presented maximum mixing ratios of 39.2 and 24.8 ppbv, respectively, inside tunnel A; acetaldehyde, a probable human carcinogenic, reached a maximum of 34.5 ppbv inside tunnel B. Since vehicle occupants that spend a significant time in urban tunnels are commonly exposed to toxic pollutant emissions, future extensive studies should be done in order to estimate exposure levels of toxic ambient air pollutants for these people. Ref: *Environ. Sci. Technol.* 2001, 35, 3071-3081.