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Experimental and numerical study of the exhaust gas dispersion of public light bus under idle condition

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ABSTRACT

Recently, air pollution has become more and more worse world widely and most cities suffer from serious air-quality problems. Vehicle emission is one of the major sources of air pollution and more attention has been paid to it especially emissions from idling vehicles, which produce extra pollutants to the surrounding air. Hong Kong government is palnning to legislate to ban the idling vehicles. So it is very significant to study the vehicle emission under idling condition and give some suggestions to our government.

The aim of the work presented here is to study experimentally and numerically the dispersion characteristics of vehicular exhaust plume under idling condition in an idealized and simplified environment. The concentrations of CO and CO_2 in the exhaust plume of public light bus were measured in a bus waiting station under calm weather condition. Despite the differences in all measurements, the time-average exhaust gas concentration diffuses exponential in the centreline of the vehicular exhaust plume and the Gaussian form is slightly fitted with the data in other two directions.

The numerical simulation is performed in a wind-tunnel using k-ε turbulence model by the CFD method. The simulated results match well with the experimental results especially close to the source of emission. The simulation results show that the concentration of exhaust gas decreases more quickly along the centreline of the vehicular exhaust plume in the downstream than other two directions. Based on the model, the effects of the incoming velocity, exit velocity and exit direction are assessed by a serious of the extended simulations. The dispersion process can be enhanced when the emit velocity is much larger than the incoming velocity. When the exit angle is less than a critical value, the exhaust gas tends to spread on the ground region. It is also found that the effect of vehicular exhaust induced turbulence in the vicinity of the pipe is more dominant than the effect of wind turbulence.

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