WIND TUNNEL SIMULATION STUDY OF THE LINE SOURCE DISPERSION AT URBAN INTERSECTION UNDER HETEROGENEOUS TRAFFIC CONDITIONS

By

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CERTIFICATE

This is to certify that the thesis entitled **"Wind tunnel simulation study of the line source dispersion at urban intersection under heterogeneous traffic conditions"** being submitted by **Mr. Kafeel Ahmad,** has been prepared under our supervision in conformity with the rules and regulations of the **Indian Institute of Technology, Delhi.** We further certify that the thesis has attained at a standard required for the award of a degree of **Doctor of Philosophy** of the institute. This work, or any part thereof, has not been submitted elsewhere for the award of any other degree or diploma.

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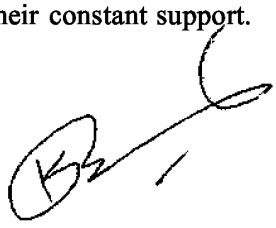

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ABSTRACT

The traffic-induced turbulence, coupled with natural air motions is important variable affecting the dispersion of exhaust emissions, especially under low wind conditions. Therefore, a systematic understanding of traffic-induced effects on exhaust dispersion mechanisms in the close vicinity of the intersection is of utmost importance in order to improve ways to mitigate vehicular pollution. In the present study an attempt has been made to investigate the effects of buildings and approaching wind directions on the line source dispersion in the close vicinity of the urban intersection. The traffic induced effects for variable traffic volume, speed and composition and approaching wind directions have also been investigated. Additionally, Plate's criterion for the scaling of traffic-induced turbulence has also been verified.

A flexible model vehicle movement system for an urban intersection having two-way straight and radial peripheral traffic flows has been designed and fabricated in the Environmental wind tunnel (EWT). The experiments have been carried out in the neutrally stratified atmospheric boundary layer, representing the urban terrain category. The tracer gas concentration has been measured, online, at one hundred ninety two locations by gas chromatograph (FID type detector) at variable approaching wind directions, i.e., 0°, 30°, 60° and 90° and traffic volumes i.e., 1200 veh/hr, 3300 veh/hr and 5400 veh/hr. The percentage reduction in normalized concentration (K) values increased with increase in the traffic volume (*'no traffic' conditions to 5400 veh/hr)* and approaching wind angles *(0° to 90°).* The maximum percentage reduction was 47.7 at 90° approaching wind direction when the traffic

volume was 5400 veh/hr. The percentage reduction further increased when traffic and wind flow directions were opposite to each other. However, the reductions in K values decreased with height of the building blocks and reached its minimum value of 1.13% at the top of the building blocks (z/Z = 0.96) for all traffic volumes. At the 'innermost corners' of the building blocks, facing the intersection, the percentage reductions in 'K' were more than at 'mid' sections of the building blocks. It may be due to generation of the corner vortices. Further, this study also verifies the applicability of the universal scaling factor $a^{1/3}$ (Plate, 1982) for the present traffic (heterogeneous), road (intersection) and wind flow conditions.

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