中文摘要

本研究以一簡易室內空氣品質模式，結合戶外量測資料探討台灣地區 PM (Particulate matter)損失機制於誘導式自然通風住宅室內/外(Indoor/Outdoor，I/O)關係。選擇之自然通風建築型態為邊牆開口一般型(sidewall openings , SP)及屋頂與邊牆皆開口之太子樓型(covered ridge with sidewall openings , CRSP)建築。考量 PM 移除機制包含通風夾帶移除及建築物表面之 PM 沉降，並採開口有效性評估自然通風量。預測 SP 及 CRSP 型建築型態之 PM2.5 及 PM10 平均 I/O 比值分別為 0.56 及 0.42。台灣中部地區亦應用已發表之資料於特定化學成分硫酸根及硝酸根 PM 質量為權重之粒徑分佈，結果顯示硫酸根及硝酸根 PM I/O 比值分別為 0.22 — 0.43 及 0.27 — 0.36。並採台灣環保署資料預測 SP 及 CRSP 型建築型態 PM10 95 百分位數值之 I/O 比值範圍分別為 0.15 — 0.24 及 0.20 — 0.32。針對誘導式自然通風空間 PM I/O 比值之影響因子進行靈敏度分析，結果顯示室外風速影響最顯著，開口面積及風入射角度次之，PM 沉降速率最低。本研究結果可說明誘導式自然通風空間中 PM I/O 比值與周圍環境 PM 分佈及建築物開口設計、風速及風入射角度有密切的關係，可提供日後誘導式自然通風空間之設計參考，以利於建築內部空氣品質之控制。

關鍵詞：顆粒物質；自然通風；開口有效性；風洞；農業設施

Abstract

We applied a simple size-dependent indoor air quality model associated with measured outdoor particulate matter (PM) profiles and potential loss mechanisms to characterize PM indoor/outdoor (I/O) relationships for wind-induced naturally ventilated residences in Taiwan region. The natural ventilation rate was quantified by the opening effectiveness for sidewall opening (SP) and covered ridge with sidewall opening (CRSP) type homes. The most significant removal mechanisms included natural ventilation through and particle deposition on indoor surfaces. The predicted average PM mass I/O ratios in SP and CRSP building types for PM2.5 and PM10 were 0.56 and 0.42, respectively. We also employed published data on mass weighted size distributions for specific chemical constitutes of PM, sulfate and nitrate, to predict PM I/O ratios in central Taiwan region, resulting values ranged from 0.22 to 0.43 and 0.27 to 0.36 for sulfate and nitrate, respectively. The predicted 95th-percentile PM10 mass I/O ratios calculated from PM data of EPA-ROC for SP and CRSP type homes were 0.15 to 0.24 and 0.20 to 0.32, respectively. The sensitivity analysis demonstrates that PM mass I/O ratios were affected by wind speed, PM deposition rate, opening area, and wind angle of incidence, whereas, the wind speed had the most significant effect than that of opening area, wind angle of incidence, and PM deposition rate. Our results show that the PM I/O ratios for a wind-induced naturally ventilated airspace depend strongly on the ambient particle distributions, building opening design, wind speed, wind angle of incidence, and outdoor PM metrics. This work will offer the designers the practical information to improve the indoor air quality control for a wind-induced naturally ventilated airspace.

***Keywords*:** Particulate matter; Natural ventilation; Opening effectiveness