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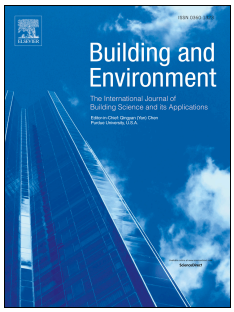

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Long-term monitoring of indoor CO_2 and PM2.5 in Chinese homes: concentrations and their relationships with outdoor environments

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Abstract

In order to investigate the current indoor air quality (IAQ) in China, we installed IAQ monitoring sensors in 117 homes. According to the results, only about 2% of homes were able to maintain an indoor PM2.5 concentration below 75 $\mu g/m^3$ during the monitoring period, and 10% of homes were able to keep the nighttime carbon dioxide (CO_2) concentration below 1000 ppm. In regard to the relationships between pollutant concentrations and outdoor environmental parameters, we found that when nighttime outdoor temperatures were between 10 °C and 22 °C, the CO_2 concentrations essentially decreased as the temperature increased. In regard to the indoor/outdoor (I/O) ratios of PM2.5, the naturally ventilated homes had a median I/O ratio of around 0.88 - 0.97 when the outdoor PM2.5 concentration was lower than 75 $\mu g/m^3$. The homes with portable air cleaners were able to maintain 39% - 100% of days with indoor PM2.5 concentrations lower than 25 $\mu g/m^3$ in different climate zones. If we want to maintain both indoor CO_2 and PM2.5 concentrations below guidelines (CO_2: 1000 ppm, PM2.5: 25 $\mu g/m^3$) for more than 95% of days during the whole year, the mechanical ventilation may be a good choice. But the efficiency of the particle filters in mechanical ventilation systems should be improved, with minimize efficiency of 86%, 85%, 74%, 58%, and 62% for severe cold, cold, hot summer and cold winter, moderate and hot summer and warm winter zones, respectively.

Keywords: Long-term monitoring; Indoor/outdoor relationships; CO_2; PM2.5

1. Introduction

Indoor air quality (IAQ) has a significant impact on human health. Among the most common indoor pollutants, PM2.5 and carbon dioxide (CO_2) are worthy of attention because their concentrations indoors are indicators of the air quality level with potential effects on occupants health and work performance. In terms of direct effects on human health, the presence of PM2.5 was found to be related to oxidative DNA damage, lung cancer and cardiovascular diseases [1, 2, 3], and Laden et al. [4] determined that improved overall mortality was associated with a decrease of PM2.5 concentration. In regard to CO_2, although it do not have a direct adverse effect on human health under normal indoor environmental conditions [5], it is

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