

Indoor PM₁₀ and its heavy metal composition at a roadside residential environment, Phitsanulok, Thailand

THUNWADEE SRITHAWIRAT

Department of Environmental Science, Faculty of Science and Technology, Pibulsongkram Rajabhat University, Phitsanulok 65000, Thailand

Corresponding author: email: T.srithawirat@psru.ac.th

MOHD TALIB LATIF

School of Environment and Natural Resource Sciences, Faculty of Science and Technology, and Institute for Environment and Development (LESTARI), University Kebangsaan Malaysia, 43600 Bangi, Selangor, Malaysia

FAZRUL RAZMAN SULAIMAN

Faculty of Applied Sciences, Universiti Teknologi MARA Cawangan Pahang, 26400 Bandar Tun Abdul Razak Jengka, Pahang, Malaysia

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RESUMEN

Se midieron concentraciones de PM₁₀ tanto en interiores como exteriores en 10 edificios residenciales de Phitsanulok, Tailandia, durante las temporadas de seca y lluvias de 2014. Además, se analizaron siete metales traza en el PM₁₀: Zn, Fe, Pb, Cd, Ni, Cu y Cr. Las concentraciones mensuales intra y extramuros de PM₁₀ fueron de 41.5 a 105.3 $\mu\text{g m}^{-3}$ y de 95.2 a 145.1 $\mu\text{g m}^{-3}$, respectivamente. Las concentraciones de PM₁₀ fueron significativamente mayores durante la temporada seca, en comparación con la temporada húmeda. Las razones interior/exterior fueron menores a uno, lo cual indica que el material particulado se origina en ambientes exteriores. En general, las concentraciones medias de metales pesados en el PM₁₀ variaron de 0.2 a 2.7 y de 0.5 a 7.1 $\mu\text{g m}^{-3}$ para el ambiente interior y el exterior, respectivamente. En el PM₁₀ de interiores se encontró una fuerte correlación positiva entre Zn y Cu, Zn y Ni, y Cu y Ni. Asimismo, se encontró una fuerte correlación entre Zn y Ni, Pb y Cu, Cu y Ni, Cd y Ni, y Zn y Cu en exteriores. Los factores de enriquecimiento de Zn, Cu, Pb, Cr y Ni fueron menores a uno, lo cual sugiere que los metales en el PM₁₀ de interiores se originaron en materiales de la corteza. En cuanto a la valoración de riesgos sanitarios, se determinó mediante una evaluación de riesgos con un sistema integrado de información, que el Cr implica el mayor riesgo de cáncer.

ABSTRACT

The concentrations of PM₁₀ were measured both indoors and outdoors at 10 roadside residential buildings in Phitsanulok, Thailand during the dry and wet seasons of 2014. Seven trace metals (Zn, Fe, Pb, Cd, Ni, Cu and Cr) were also analysed in PM₁₀. The monthly average concentrations of indoor and outdoor PM₁₀ were 41.5 to 105.3 $\mu\text{g m}^{-3}$ and 95.2 to 145.1 $\mu\text{g m}^{-3}$, respectively. PM₁₀ concentrations were significantly higher during the dry season compared to the wet season. The indoor/outdoor (I/O) ratios were less than one indicating that the particulate matter originates from the outdoor environment. Overall, the average concentrations of heavy metals in PM₁₀ ranged from 0.2 to 2.7 $\mu\text{g m}^{-3}$ and 0.5 to 7.1 $\mu\text{g m}^{-3}$ for the indoor and outdoor environments, respectively. A strong positive correlation in indoor PM₁₀ was found between Zn and Cu, Zn and Ni, and Cu and Ni. Zn and Ni, Pb and Cu, Cu and Ni, Cd and Ni, and Zn and Cu showed strong positive correlations in the outdoor environment. The enrichment factors of Zn, Cu, Pb, Cr and Ni were less than one suggesting that the metals in indoor PM₁₀ have originated from crustal materials. For the health risk assessment, Cr was found to have the highest excess cancer risk in an evaluation using an Integrated Risk Information System.