

Indoor Air Assessment and Health Risk of Volatile Organic Compounds in Secondary School Classrooms in Benin City, Edo State, Nigeria

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Abstract : The school environment, apart from home, is probably the most important indoor environment for children. Children spend as much as 80-90% of their indoor time either at school or at home; an average of 35 - 40 hours per week in schools, hence are at the risk of indoor air pollutants such as volatile organic compounds (VOCs). Concentrations of VOCs vary widely but are generally higher indoors than outdoors. This research was, therefore, carried out to evaluate the levels of VOCs in secondary school classrooms in Benin City, Edo State. Samples were obtained from a total of 18 classrooms in 6 secondary schools. Samples were collected 3 times from each school and from 3 different classrooms in each school using Draeger ORSA 5 tubes. Samplers were left to stay for a school-week (5 days). The VOCs detected and analyzed were benzene, ethylbenzene, isopropylbenzene, naphthalene, n-butylbenzene, n-propylbenzene, toluene, m-xylene, p-xylene, o-xylene, styrene, chlorobenzene, chloroform, 1,2-dichloropropane, 2,2-dichloropropane, tetrachloroethane, tetrahydrofuran, isopropyl acetate, α -pinene, and camphene. The results showed that chloroform, o-xylene, and styrene were the most abundant while α -pinene and camphene were the least abundant. The health risk assessment was done in terms of carcinogenic (CRI) and non-carcinogenic risks (THR). The CRI values of the schools ranged from 1.03×10^{-5} to $1.36 \times 10^{-5} \mu\text{g}/\text{m}^3$ (a mean of $1.16 \times 10^{-5} \mu\text{g}/\text{m}^3$) with School 6 and School 3 having the highest and lowest values respectively. The THR values of the study schools ranged from 0.071-0.086 $\mu\text{g}/\text{m}^3$ (a mean of 0.078 $\mu\text{g}/\text{m}^3$) with School 3 and School 2 having the highest and lowest values respectively. The results show that all the schools pose a potential carcinogenic risks having CRI values greater than the recommended limit of $1 \times 10^{-6} \mu\text{g}/\text{m}^3$ and no non-carcinogenic risk having THR values less than the USEPA hazard quotient of 1 $\mu\text{g}/\text{m}^3$. It is recommended that school authorities should ensure adequate ventilation in their schools, supplementing natural ventilation with mechanical sources, where necessary. In addition, indoor air quality should be taken into consideration in the design and construction of classrooms.

Keywords : carcinogenic risk indicator, health risk, indoor air, non-carcinogenic risk indicator, secondary schools, volatile organic compounds

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