

Quantification of Size Segregated Particulate Matter Deposition in Human Respiratory Tract and Health Risk to Residents of Glass City

Authors : Kalpana Rajouriya, Ajay Taneja

Abstract : The objective of the present study is to investigate the regional and lobar deposition of size-segregated PM in respiratory tract of human body. PM in different fractions is monitored using the Grimm portable environmental dust monitor during winter season in Firozabad; a Glass city of India. PM₁₀ concentration ($200.817 \mu\text{g}/\text{m}^3$) was 4.46 and 2.0 times higher than the limits prescribed by WHO ($45 \mu\text{g}/\text{m}^3$) and NAAQS ($100 \mu\text{g}/\text{m}^3$) government agencies. PM_{2.5} concentration ($83.538 \mu\text{g}/\text{m}^3$) was 5.56 and 1.39 times higher from WHO ($15 \mu\text{g}/\text{m}^3$) and NAAQS ($60 \mu\text{g}/\text{m}^3$) limits. Results inferred that PM₁₀ and PM_{2.5} was highest deposited in head region (0.3477-0.5622 & 0.366-0.4704) followed by pulmonary region, especially in the 9-21 year old persons. The variation in deposition percentage in our study is mainly due to the airway geometry, PM size, and its deposition mechanisms. The coarse fraction, due to its large size, cannot follow the airway path and mostly gets deposited by inertial impaction in the head region and its bifurcations. The present study results inferred that Coarse and fine PM deposition was highly visualized in 9 ($8.456 \times 10^{-4} \mu\text{g}$, $2.911 \times 10^{-4} \mu\text{g}$) year and 3 ($1.496 \times 10^{-4} \mu\text{g}$, $8.593 \times 10^{-5} \mu\text{g}$) month age category. So, the 9 year children and 3 month infants category have high level of health risk.

Keywords : particulate matter, MPPD model, regional deposition, lobar deposition, health risk

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