

DISPERSION OF RESPIRABLE PARTICLES ESCAPING FROM ACTIVE OPENCAST COAL MINES

Thesis Abstract

The findings presented in this thesis are based on the studies conducted in two large opencast coal projects in India. The objectives were to quantify the PM concentration (PM_{10} , $PM_{2.5}$ and PM_1) escaping from an active mine, its spatial and temporal variations in mine surrounding, and development and validation of an empirical model for prediction of PM_{10} , $PM_{2.5}$ and PM_1 level in the surrounding of a mine. Test of equality of means, correlation analysis, curve estimation regression, stepwise regression analysis and General Linear Model univariate procedure (analysis of covariance (ANCOVA)) were used for data analysis.

The results suggest that at a distance of 500 m from the mine, the PM concentrations were higher than the local background level (1.52, 1.80 and 1.89 times for PM_{10} , $PM_{2.5}$ and PM_1 at Mine 1 and 1.4, 1.35 and 1.35 times for PM_{10} , $PM_{2.5}$ and PM_1 at Mine 2). It did not meet the respirable particle concentration (PM_{10} and $PM_{2.5}$) limit values set by NAAQS, India and major global ambient air quality standards. Opencast mine deploying surface miners for coal cutting and tippers for coal evacuation additionally contributed up to 2.74-3.89, 1.66-3.27 and 2.35-2.77 times the background concentration of $PM_{2.5-10}$, $PM_{1-2.5}$ and PM_1 respectively to the PM level at pit boundary. For $PM_{2.5}$ and PM_1 concentrations, RH was the most important determinant ($PM_{2.5}$: 24.8%; PM_1 : 30.1%). Distance (20.8%) was the important determinant of PM_{10} concentrations. All the four predictors (RH, wind speed, distance and Pit boundary PM concentration; we excluded temperature due to collinearity with RH) could explain 46-54% variability in the PM concentrations. Inclusion of pit boundary PM concentration increased the prediction capability of the models. Model validation study showed that the models are reasonably good ($IA \approx 0.75$) in predicting the PM concentrations. The results of the study can help the occupational health scientist to further investigate the impact of mining on health of residents living in close proximity to the mine. PM prediction model can be used by the mining and regulatory authorities to assess the respirable PM level in mine surroundings.