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Atmospheric chemical composition of bulk precipitation in different regions of Gampaha District

E. A. C. P Edirisinghe[1] and M. P. Deeyamulla[1*]

[1]Department of Chemistry, University of Kelaniya, Sri Lanka
mpd@kln.ac.lk*

Wet and dry deposition, both referred to as bulk precipitation, are the two methods of removing gases and particulates from the atmosphere. This research primarily focuses on bulk precipitation analysis to evaluate the pollution sources and the extent of seasonal characteristics of precipitation for air quality monitoring in the vicinity of Kerawalapitiya-Yughadhanavi Power Plant, the largest oil-fired power plant, and Sapugaskanda Oil Refinery, the single largest oil refinery in Sri Lanka. During the northeast and first intermonsoon seasons, 30 rainwater samples were collected over a five-month period from November 2021 to March 2022, in Kerawalapitiya (site A), Sapugaskanda (site B), and Kadawatha (site C), all densely populated and heavily industrialized areas, and Keragala (background site D), a rural area in Gampaha district where anthropogenic influence is minimal. Based on volume weighted mean (VWM) pH variation, Kadawatha area showed acidic precipitation (5.21±0.3) during the study period, while sites A (6.81±0.3), B (5.75±0.8) and D (6.12±0.2) had alkaline pH values. The neutralization factors (NFs) for the major cations (Na^+, K^+, Mg^{2+},Ca^{2+}, and NH_4^+) in the precipitation indicated that higher levels of Na^+ and NH_4^+ contributed to the neutralization of the acidic components at sites A and D, respectively. The VWM concentrations of ionic species were determined by ion chromatography followed the order of $Na^+ > Ca^{2+} > SO_4^{2-} > Mg^{2+} > NO_3^- > Cl^- > NH_4^+ > K^+ > Br^- > F^-$ in Kerawalapitiya, $NO_3^- > SO_4^{2-} > Ca^{2+} > Na^+ > Cl^- > K^+ > NH_4^+ > Mg^{2+} > Br^- > F^-$ in Sapugaskanda and $SO_4^{2-} > NO_3^- > Na^+ > K^+ > Cl^- > Ca^{2+} > Mg^{2+} > Br^- > F^-$ in Kadawatha. Nevertheless, Keragala showed a relatively low ionic composition, and it was in the order of $NO_3^- > NH_4^+ > Na^+ > Cl^- > Ca^{2+} > K^+ > SO_4^{2-} > Mg^{2+} > Br^- > F^-$. There was a reduction in the VWM SO_4^{2-} concentration in the Sapugaskanda site compared to a previous study done in this area in 2021. This may be due to the time-to-time shutdown of the Sapugaskanda oil refinery during the study period for the first time since 1969. Enrichment factors (EFs) associated with the sea (EF_{sea})and crust (EF_{crust}) confirmed that the Cl^- ions at all four sites were marine in origin, although Ca^{2+}, K^+, and SO_4^{2-} were not from marine sources. In addition, the values of EF_{sea} and EF_{crust} for SO_4^{2-} and NO_3^- showed greater than 1 in all four sites. This may be due to human activities in the study area. Also, Mg^{2+} has a significant contribution from both marine and soil at sites B, C, and D, while it is of anthropogenic origin at site-A. VWM metal concentrations determined by ICP-MS revealed that all sites had higher values for Al, Mg, K, and Zn, but lower concentrations of Cd, As, Co, and Cr. The results of this study further confirmed that rainwater analysis is an indirect indicator of air quality in a given area.

Keywords: Air quality, Bulk precipitation, Ionic composition, Monsoon seasons