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Major ion chemistry of rainwater and occurrence of acid rain over Dhanbad, coal city of India

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Deposition of atmospheric pollutants is a serious threat to human environment, such as vegetation, soil, water, forestry etc. and therefore, the research on deposition monitoring and its effects on human environment are going on extensively in many countries of the world. Emission of sulphur and nitrogen oxides into the atmosphere in Asia, Europe and North America have resulted in wide spread environmental effects including acidification of soils, surface waters, ground waters, injury to vegetation, corrosion of building materials and decreased visibility. Ammonia and alkaline dust are able to neutralised acidic components and thus influence the extent of acidic precipitation. The occurrence of acid rain has been documented by an ever-increasing number of studies around the world including India and the published data have been useful in evaluating atmospheric pollution localities.

The present study investigated the chemical composition of wet atmospheric precipitation over Dhanbad, coal city of India. The precipitation samples were collected on event basis from July 2003 to October 2004 at Central Mining Research Institute, Dhanbad. The precipitation samples were analyzed for pH, conductivity, major anions (F, Cl, NO_3, SO_4) and cations (Ca, Mg, Na, K, NH_4). The pH value varied from 4.01 to 6.72 (avg. 5.08) indicating acidic to alkaline nature of rainwater. The pH of the rainwater was found well above the reference pH (5.6), showing alkalinity during the non-monsoon and early phase of monsoon, but during the late phase of monsoon, pH tendency was towards acidity (<5.6 pH) indicating the non-availability of proper neutralizer for acidic ions. The seasonal variation in ionic concentration shows a sharp increase in concentration of Ca, Mg, Na and K during the dry months (post and pre-monsoon) and low concentration in wet months (July-October). Seasonal concentrations of major anions (SO_4, Cl, F and NO_3) are also characterized by monsoon minima and non-monsoon maxima. Such seasonal pattern might be caused by the least mean precipitation and enhanced suspended particulates in the lower atmosphere during the dry periods. The $(NO_3+Cl)/SO_4$ ratio in majority of samples was found below 1.0, indicating that the acidity is greatly influenced by SO_4. The calculated ratio of (NO_3+SO_4) to (NH_4+Ca) ranges 0.19 to 2.37 (average, 0.92), however in most of the samples, the ratio is less than unity (<1.0) indicating that NH_4 and Ca play an important role in neutralization of acidic ions in rainwater. The dominance of non-sea salt fractions (nss) of majority of the ions and good correlation of SO_4 and NO_3 with the Ca, Mg, Na and K indicated that atmospheric dust and soil play a significant role in precipitation chemistry of Dhanbad city.