Title of the Project "Distribution of toxic metals in dry and wet atmospheric depositions in mining areas of Singhbhum, Jharkhand"

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Project Duration: 2 years (01.Sep.2017 to 31.Aug.2019)

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Executive Summary

The study was carried out in the Copper mining areas of East Singhbhum and Iron mining areas of the West Singhbhum. The study was related to the metals in the wet deposition (Rain water) and dry deposition (Atmospheric dustfall, Road dust and Leaf dust). A total of 102 rainwater samples, 60 atmospheric dust samples, 38 samples of road dust and 20 samples of leaf dust have been analyzed in the project. The objectives including the estimation of deposition rate of the contaminants, statistical source apportionment of metals and mineralogical investigation of the dust samples has been full field. Majority of the rain water samples collected from both the mining areas falls in the pH range of <5, however, rain water collected from the close vicinity of the industrial activities at Adityapur depicted a higher pH i.e. 5.6-6.0. The average TDS of the rain water samples of all the locations were found to be less than 25mg/l. The metal concentration of the rain water samples were well within the Indian drinking water standards (IS: 10500). The statistical source apportionment (PCA) suggested both innate and anthropogenic sources as the contributors of the metals in the rain water. Average dustfall rate of summer and winter seasons varied from 7.51-28.51 g/m^2/month and 7.40-26.37 g/m^2/month, respectively in the mining area of East Singhbhum with the highest dustfall occurring at the industrial area of Adityapur. Average dustfall rate of summer and winter seasons varied from 7.23-76.99 g/m^2/month and 6.48-73.92 g/m^2/month, respectively in the mining area of West Singhbhum with the highest dustfall occurring at the Hathigate, which is under the influence of extensive traffic load. During the summer season, atmospheric dustfall rates were found to be higher than winter due to enhanced dispersion caused by high wind speed. The lower rates were observed during winter season due to washout by monsoonal rainfall and higher relative humidity, which reduces re-suspension of dust.

For the East Singhbhum area, highest metal concentration was in dustfall was found to be at Adityapur due to small industrial activities at Kandra and Adityapur industrial area and heavy traffic at Jamshedpur. Highest metal concentration in dustfall was depicted for the location at Hathigate in the West Singhbhum area which may be attributed to heavy vehicular activities. The metal concentrations in dustfall of both the study areas exceeded the values of the average concentration of metals in the shale for almost all the metals. As the study areas are characterized by the presence of metal bearing formations accompanied with extensive mining and industrial activities, elevated levels of metals in the dustfalls can be anticipated. The multivariate analysis suggested both geogenic and anthropogenic sources mainly mining and vehicular activities to be the contributors of the metals in the free fall dust for both the mining areas. The Enrichment factor and Geo-accumulation index suggested very heavy pollution with respect to Cu followed by Zn in the East Singhbhum mining areas and moderate pollution with respect to Fe, As, Pb and Zn for the Iron mining area of the West Singhbhum.The mineralogical characteristics of atmospheric dustfall samples were obtained by means of X-ray diffraction (XRD) analysis. The major minerals found in the dust samples of East Singhbhum are quartz, muscovite, chlorite, calcite, chalcopyrite, albite, gypsum and dolomite. The major minerals found in the dust samples of West Singhbhum are quartz, Cristobalite, Hematite, Magnetite, Biotite, Albite, Ilmenete, Pyrite, Rutile and dolomite.The metal concentrations in road dust and foliar dust of both the study areas exceeded the values of the average concentration of metals in the shale and world average for almost all the metals. As the study area is characterized by the presence of metal bearing formations accompanied with extensive mining and industrial activities, elevated levels of metals can be anticipated. The Enrichment factor and Geo-accumulation index suggested very heavy pollution with respect to Cu and Zn in the road dust collected from East and West Singhbhum mining areas, respectively. The Enrichment factor and Geo-accumulation index suggested very heavy pollution with respect to Cu and Cr in the leaf dust collected from East Singhbhum mining area and for Fe and Zn in the leaf dust collected from West Singhbhum mining area. The multivariate analysis suggested both geogenic and anthropogenic sources mainly mining and vehicular activities to be the contributors of the metals in the road and foliar dust for both the mining areas. The final report has been submitted and Research article preparation is in progress and 1 manuscript has been communicated to SCI journal.

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