Assessment of Oil and Grease in Ground and Surface Water Within The Vicinity of Choutuppal in Hyderabad, India

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Abstract- *The present study discusses an assessment of oil, grease, total petroleum hydrocarbons (TPH) and some heavy metals in surface and ground water within and around the Nigeria National Petroleum Corporation (NNPC) depot, in Apata, Ibadan metropolis in other to assess the pollution status of the water. Samples were collected randomly within and around the depot. Control samples were taken from Awba dam and Obafemi Awolowo hall of residence, within the University of Ibadan. TPH, oil and grease were analyzed gravimetrically while the levels of heavy metals were determined by atomic absorption spectrophotometry (AAS) The results revealed the presence of oil and grease in both surface and ground water with a value ranging from 59.74±4.92 to 67.35±2.21, and 10.48+1.21 to 34.94+5.04 mg/l compared to control sample with a value of, 37.21±4.77 and 12.17±0.78 mg/l respectively. Conversely, high values of TPH were recorded for both surface and groundwater in the studied area ranging from, 20.34±1.79 to 27.40±5.32 and 2.67±0.80 to 13.03±2.21mg/l respectively as against the control of 13.18±2.41 and 1.58±0.22 mg/l. The level of heavy metals concentration recorded in both surface and groundwater samples of studied sites were ranged from 0.162±0.015 to 0.195±0.011mg/l Pb, 0.279±0.088 to 0.315±0.085mg/l Cd, 5.063±0.377 to 5.096±0.373mg/l Zn, 0.103±0.0207 to 0.133±0.036mg/l Ni, 8.744±0.112 to 10.307±0.387mg/l Cu and 0.052±0.006 to 0.059±0.013mg/l Cr for surface water respectively while groundwater contained as much as 0.046±0.016 to 0.156±0.023mg/l Pb, 0.016±0.004 to 0.045±0.003mg/l Cd, 1.560±0.061mg/l to 2.972±0.136mg/l Zn, 0.015±0.006 to 0.315±0.037mg/l Ni, 2.256±0.121 to 4.820±0.288mg/l Cu and 0.0033±0.013 to 0.073±0.009mg/l Cr. A statistically significant difference at $p<0.05$ was found to exist between the concentrations of oil and grease, TPH and the analyzed metals collected from the sites and the control sites. Based on this study, the human and environmental risk to TPH, oil and grease, Pb, Cr, Ni, Cu, Cd and Zn in surface and ground water are high for now, as the concentrations were higher than those of the control sites and the recommended permissible limit of the World Health Organization (WHO), European and Union (EU). It is therefore recommended among others that primary treatment plant be install in all NNPC depot for the uptake of these toxicants which may pose treat to human health on bioaccumulation.*

I. INTRODUCTION

India has experienced rapid industrial growth since the enactment of the economic liberalization policies in the 1990's. Industrialization has become an important factor to the development of country's economy, through the establishment of plants and factories. However, the untreated or partly treated effluents discharged from them are an obvious source of groundwater pollution. Groundwater is generally less susceptible to contamination as compared to surface water bodies. However, where groundwater is used intensively for irrigation and industrial purposes, a variety of land and water-based human activities are causing pollution of this precious resource. Therefore, groundwater management has become critical issue for current and future generations.

After the first bulk drug unit (M/s Divis Laboratories Ltd, Lingojigudem) started operation in Choutuppal during 1995, more than 30 bulk drug and drug intermediates units and 15 other category units like biotechnology, pesticide formulation, waste paper recycling unit, heavy engineering unit etc were established till date in this area with in 10 km radius. The area consists of dry lands, hillocks and agricultural lands. Agricultural activity is being mainly done with groundwater as the rainfall in this area is below average. Musi river, Ramasamudram and Aregudem Cheruvus are located in the downstream and this situation leads to the exploitation of groundwater for industrial purposes and agricultural purposes. In addition to the above, there were complaints of illegal discharges by some of the units by lorry tankers/ dumping into abandoned bore wells within the industrial premises. Earlier studies on ground water quality of the region revealed that many of the groundwater samples showed high amount of COD and TDS indicating contamination. Furthermore, it was ascertain to conclude whether the actual contamination is due to effluents being disposed into the bore wells or due to geogenic origin or hydrology of the area. The thematic focus of this present study, is to examine the levels of oil and grease, and consequent heavy metals; Arsenic (As), Boron (B), Barium (Ba), Cadmium (Cd), Cobalt (Co), Chromium (Cr),

Copper (Cu), Iron (Fe), Mercury (Hg), Manganese(Mn), Nickel (Ni), Lead (Pb), Zinc (Zn) in ground water, surface water and the samples of effluents from the industries, within the vicinity of the choutuppal industrial area, telangana. This study is expected to provide baseline data as an aspects of environmental impact assessments that will assist in determining the level of remediation that these water sources may require overtime if contaminated as well as to alert the appropriate environmental regulatory agencies on the need to formulate and enforce a comprehensive environmental action plan towards protecting the environment.

II. METHODS AND MATERIALS

Sampling and samples description

Choutuppal Mandal is located between the latitudes from 17 7' 32" N to 17 24' 27" N and the longitudes from 78 42' 27" E to 79 10' 57" E with about 20 industries in the area. 32 ground water locations from various bore wells and tube wells and hand pumps in and around the industries were selected randomly for sampling for the purpose of this study, 2 surface water i.e. lakes were in the choutuppal mandal were selected for surface water sampling, 15 effluents from various industries in the choutuppal mandal selected for raw water effluent sampling. The collection of samples were done in plastic bottles which were thoroughly cleaned and rinsed in distilled water and the sample bottles are labelled properly. The sample containers were tightly sealed immediately after sample collection. Sampling was carried out in summer of April 2016. The location mapping of the sampling points of the surface water, ground water and the effluents from the industries are listed in the table below.

Table 1- Table showing the effluent sample details

S.No	Sample Code	Location	Latitude	Longitude
1	CU-I-17W	Symed Labs Ltd, Unit – VI, (Formerly M/s. Plasma Labs (P) Ltd.,) Sy. No: 750, Mandollagudem (V)	17° 17' 4"	78° 54' 57"
2	CUV-I-20W	Brundhavan Laboratories Ltd., Yellagiri	17° 16' 31"	78° 50' 27"
3	CU-I-9W	Discovery Intermediates (P) Ltd., Thangadapally	17° 18' 09"	78° 51' 45"
4	CU-I-8W	S.V. Labs (P) Ltd., Sy.No. 501, 506 & 507, Koyyalagudem (V)	17° 15' 09"	78° 51' 15"
5	CU-I-10W	Accrete Pharmaceuticals (P) Ltd, Sy.No. 706 / B, 707 / B, Thangadapalli (V)	17° 15' 03"	78° 51' 34"
6	CU-I-7W	YL Drugs limited, koyyelagudem	17° 15' 13"	78° 51' 20"
7	CU-I-2W	Fugen Laboratories (P) Ltd., Sy. Nos. 736 & 737, Mandollagudem V)	17° 17' 02"	78° 55' 23"
8	CU-I-3W	Vision Drugs (P) Ltd., Sy. No. 733, Mandollagudem (V)	17° 17' 05"	78° 55' 07"
9	CU-I-4W	Spica Laboratories (P) Ltd. S. Lingotam (V)	17° 17' 27"	78° 55' 40"
10	CU-I-6W	VC (Srinidhi) Drugs & Chemicals (P) Ltd, Sy.No. 283 to 285, S. Lingotam (V)	17° 17' 47"	78° 56' 6"
11	CU-I-11W	Shree Jaya Laboratories (P) Ltd., Sy. No. 29 & 299/AA, Malkapur (V), Choutuppal (M)	17° 17' 29"	78° 49' 51"
12	CU-I-12W	Ortin Laboratories Ltd., (Formerly M/s. Vineet Laboratories (P) Ltd.), Sy. No. 300, Malkapur (V)	17° 17' 33"	78° 49' 10"
13	CU-I-14W	Divis Laboratories, Unit-1	17° 14' 3"	78° 55' 38"
14	CU-I-15W	SR Laboratories (P) Ltd., Jaikesaram (V)	17° 18' 41"	78° 58' 46"
15	CU-I-16W	Srini Pharmaceuticals Ltd.	17° 14' 39"	78° 54' 58"

Oil and grease extraction from the samples

Liquid – liquid extraction procedure was used to extract the oil and grease from the sample with the help of hexane.

250ml of sample was extracted in a separating funnel fitted with a glass stopper using 25ml hexane as the extractant. The separating funnel was shaken vigorously for 2 minutes and the hexane layer was allowed to separate for 2 minutes from the aqueous phase after which the organic layer was collected into a beaker thoroughly washed, cleaned and double rinsed with distilled water and oven dried at 60C for 1 hour to remove any moisture from the beaker. The initial weight (the washed and dried beaker weight) is noted and the hexane collected in the beaker is covered with an aluminium foil promptly poked with holes for the escape of the fumes of hexane when left to escape in the atmosphere. The final weight of the beaker after all the hexane has evaporated is collected for every sample and the difference in the weight is equivalent to the oil and grease in the sample.

Mg/L (oil & grease) =
A= final weight after the experiment for the sample
B= final weight after the experiment for blank / initial empty weight of the beaker for the sample

Heavy metal analysis

The determination of heavy metals was performed with a bulk scientific 205 atomic absorption spectrophometer. The instrument's setting and operational conditions were done in accordance with manufacturer's specifications. The instrument was calibrated with analytical-grade metal standard stock solutions (1 mg/L) in replicate. 150 ml of sample was transferred to a beaker, 5 ml concentrated HNO3 was added and the mixture evaporated almost to dryness on a hot plate. 1-2 ml of concentrated HNO3 was added to dissolve the residues on the walls of the beaker. The distilled, digested samples were filtered and made up to 50 ml and analyzed using AAS. Blank was prepared by carrying distilled deionized water through the whole procedure above. Sample were prepared for analysis, following the methods described earlier [23]. 150 ml of water sample in 5 ml concentrated HNO3 was used. Samples pH was determined insitu using portable pH meter after calibration with buffer solutions of pH 4.00 and 7.00 respectively.

III. RESULTS AND DISCUSSIONS

The physical parameter analysis indicates that the pH was normal and varied from 6.28 to 8.41. Below the acceptable level of pH (6.28) was observed at sampling station, CU-1-16. The Oil & Grease content in all the ground

water samples were found to be above the acceptable limit of 0.5 mg/l except at station CU-V-21, where it was below detectable level (BDL).

The summary of the groundwater quality parameters with respect to heavy metals in the entire study area is shown in

Table 5. The metals like As, B, Ba, Cd, Co, Cr Cu, Fe, Mn, Ni, Pb and Zinc are monitored in the raw Effluent samples of each industry and is presented in **Table 6.**

Table 4- Oil and grease of raw water effluent from industries in the study area

S.No	Sampling code	Oil and grease(mg/L)
1	CU-I-2W	93
2	CU-I-3W	131
3	CU-I-4W	1541
4	CU-I-6W	45
5	CU-I-7W	4401
6	CU-I-8W	15
7	CU-I-9W	47
8	CU-I-10W	508
9	CU-I-11W	623
10	CU-I-12W	201
11	CU-I-14W	10530
12	CU-I-15W	686
13	CU-I-16W	17
14	CU-I-17W	126
15	CU-I-20W	19

Arsenic (As) at many sampling stations found to be BDL and within the acceptable limit of 10 µg/l. However, it ranged from BDL to 2.55 µg/l at all sampling stations in the study area. Similarly, boron (B) at many locations found to be within acceptable limit of 0.5 mg/l except at stations like CU-V-13, CU-I-4 & CU-I-16. The boron content at these locations varied from 1.22 to 6.03 mg/l. Barium also observed to be below the acceptable limit 0.7 mg/l at many sampling stations except at CU-V-15 & CU-I-20 (Choutuppal mandal village). Cadmium (Cd) in the study area was found to be below the acceptable limit of 0.003 mg/l (IS: 10500: 2012 Drinking water Specifications) except at CU-V-2, CU-V-13 & CU-V-26 (Choutuppal mandal villages) and CU-I-15 (Choutuppal mandal industry). It varied from 0.0065 to 0.0305 mg/l at these locations.

Cobalt and chromium ranged from BDL to 0.0112 mg/l and 0.00089 – 0.01195 mg/l respectively at all sampling stations in the study area. In general, the concentration of both iron and copper at all locations found to be within acceptable limit 0.05 mg/l and 0.3 mg/l, respectively, however, they ranged from BDL to 0.139 mg/l and BDL to 2.029 mg/l. Manganese at all sampling stations varied from BDL to 20.935 mg/l in the study area. Many locations including Choutuppal mandal villages (CU-V-7, CU-V-13 & CU-V-15) and Choutuppal mandal industries (CU-I-4 & CU-I-20) showed values more than the acceptable limit of 0.1 mg/l. In general, nickel found to be below the acceptable limit 0.02 mg/l in the study area. Lead content at all locations found to be below the acceptable limit of 0.01 mg/l except at CU-V-1, CU-V-2, CU-V-9, CU-V-13, CU-V-20, CU-V-25 & CU-V-26 (Choutuppal mandal village); and CU-I-1 & CU-I-15 (Choutuppal mandal industries). Zinc levels varied from BDL to 2.72 mg/l in the study area many sampling stations showed below detectable level.

The observed concentrations of heavy metals in all the clusters of industrial effluents in the study area are found some as BDL and mostly as very high.

IV. CONCLUSIONS

The physical parameters analysis indicate that the pH and turbidity values of all the samples are within the acceptable limit as per BIS standards.

Both arsenic and zinc content in groundwater were within the acceptable limits of BIS standards in the study area. Boron was the above permissible limit (1.0 mg/l) in Choutuppal mandal village and Choutuppal mandal industries while Barium was above the permissible limit in samples of Choutuppal mandal industries and Choutuppal mandal village. Other heavy metals like cadmium, copper and iron, nickel and lead were found to above the above the acceptable limit while manganese, nickel and lead were above the permissible limit at many sampling stations in the study area.

The heavy metal (hexavalent chromium, total chromium, zinc, lead, nickel, cadmium, cobalt, manganese, iron and copper) concentrations in the soils of study area were low to normal range.

In general, the high values of TDS and other parameters in the groundwater appeared to be caused by the dissolution mineral phases and also due to the discharge of industrial effluents or anthropogenic activities.

The groundwater/surface water quality of the different industries tube wells (14 Industries out of 20) in Choutuppal mandal showed high TDS values above permissible limit. All the tube wells are located inside the premise of each industry. It was observed that water levels in the industry tube wells were high compared to ground water wells in the surrounding area (villages). This might be attributed to the direct disposal of effluents into deep tube

wells before the implementation of Zero Liquid Discharge (ZLD) system.

The oil & grease content in all the groundwater samples of the study area were above the acceptable limit except at very few locations. Higher values of oil & grease indicate that the groundwater contamination may be due to discharge of industrial effluents in aquifer systems

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