Research Article

Evaluation of ground water quality in the vicinity of Agro Paper mills, Polamuru

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ABSTRACT

Analysis of heavy metals in ground water samples has been carried out from eight sampling stations for a period of 6 months (ie., April 2012 to Sept. 2012) in the vicinity of Agro Paper industries, Polamuru village , East Godavari Dt.(A.P.). The parameters such as pH, temperature, hardness, aluminum, iron, copper, chromium, manganese, mercury lead and zinc have been analyzed. It is observed that all the parameters analyzed indicate that water is suitable for both domestic as well as irrigation purposes.

Keywords: Heavy metals, Pollution, Agro Paper industries, Polamuru.

INTRODUCTION

The "heavy metals" include chromium (Cr), iron (Fe), cadmium (Cd), manganese (Mn), lead (Pb) and zinc (Zn) are the most toxic to aquatic organisms. Heavy metal pollution can arise from many sources but most commonly arises from the purification of metals, e.g., the smelting of copper and the preparation of nuclear fuels. Electroplating is the primary source of chromium and cadmium. Today mankind is exposed to the highest levels in recorded history of lead, mercury, arsenic, aluminum, copper, nickel, tin, antimony, bromine, bismuth and vanadium. Levels of exposure to toxic metals are up to several thousand times higher than in primitive man[1]. It is also known fact that no metal is degradable. An affected enzyme by these toxic metals are solely responsible to many health conditions Diseases such as renal failure, liver cirrhosis, hair loss, and chronic anemia are apparently related to contaminated drinking water[2] with heavy metals such as Cd, Cr, Cu, Fe, Mn, and Pb . Through precipitation of their compounds or by ion exchange into soils and mud, heavy metal pollutants can localize and lay dormant. Unlike organic pollutants, heavy metals do not decay and thus pose a different kind of challenge for remediation [3,4] . In view of this, it is proposed to carry out physico- chemical analysis of water samples from Agro Paper industries, Polamuru village, East Godavari Dt.(A.P.).

EXPERIMENTAL

Eight sampling stations were selected for the analysis of waters belonging to Lakshmi Prasanna Agro Paper industries ltd, Polamuru village (Anaparthi mandal E.G. Dt)., selected bellow: S1–- N.T.R.colony(Bore Well), S2– Main road street (Bore Well), S3 –Devi chowk centre (Bore Well),S4–Ramalayam centre (Bore Well), S5 – Chinna Polamuru area(Bore well water),S6 – SC peta area (Bore Well) ,S7 – M.P.P High school area (Bore Well) and S8 Panchayath area (well water). The samples collected in 1lt. sterilized bottles were preserved with 2 mL nitric acid to prevent the precipitation of metals. They were then concentrated and subjected to nitric acid digestion. The samples were analyzed5 in each month during April 2012 to Sep 2012. All the chemicals and reagents used were of analytical grade. D.D water was used for the preparation of solutions. Heavy metal analyses were carried out using Atomic absorption spectrophotometer. The pH of water samples was determined by a pH-meter and conductivity was measured by a conductivity meter (Systronics).The results obtained were compared with WHO(2011) and Indian standards for drinking water.

RESULTS AND DISCUSSION

The results obtained on the analysis of heavy metal concentrations at different stations are summarized in Tables – 1 to 6.

A rise in temperature of water leads to the speeding up of chemical reactions in water, reduces the solubility of gases and amplifies the tastes and odors6. The average temperature of the present study ranged from 26.76 - 28.28°C.
Acid base reactions are important in ground water because of their influence on pH and the ion chemistry. Higher levels of pH and alkalinity tend to reduce toxicity of metals in water7. The pH values of the present investigation were within the prescribed standards (7.0 – 8.5).

Aluminum (Al)
The concentration of aluminum in natural waters can vary significantly depending on various physicochemical and mineralogical factors. Dissolved aluminum concentrations in waters with near-neutral pH values usually range from 0.001 to 0.05 ppm but rise to 0.5–1 ppm in more acidic waters or water rich in organic matter. Symptoms including nausea, vomiting, diarrhoea, mouth ulcers, skin ulcers, skin rashes, and arthritic the symptoms were mostly mild and short-lived[8]. Aluminum content of the present study indicates that the values were within the limits.

Chromiuim (Cr)
Both the forms of chromium [Cr (VI) and Cr (III)] are biologically important. Trivalent chromium is found to be essential to human beings and animals and it plays vital role in insulin metabolism as the glucose tolerance factor (GTF). Cr (VI) is more toxic than Cr (III). It is also responsible for chrome ulcer and kidney damage7. The maximum concentration of Cr(VI) permitted in domestic water supplies is 0.05 ppm [9] .
Other sources of contamination of chromium in the environment are Chlor-alkali, electroplating, leather textiles, pigments, dyes, metal finishing, mining and metallurgical industries. The ash from thermal plants of burning of coal as fuel in various industries contain significant amount or Cr which seeps through earth and affects the fertility of land. Cr content of the present varied between ND to .0.052ppm.

Cadmium (Cd)
Cadmium can be released to the environment human activities, such as tobacco smoking, mining, smelting and refining of non-ferrous metals, fossil fuel combustion, incineration of municipal waste (especially cadmium containing batteries and plastics), manufacture of phosphate fertilizers and erosion, and river transport the contamination of watercourses by drainage water from metal mines. Cigarette smoking can cause significant increases in the concentrations of cadmium in the kidney, the main target organ for cadmium toxicity[10.] Cd content of the present varied between ND and 0.074ppm

Iron (Fe)
Although it is abundant in earth's crust, it is absorbed in different forms at different rates . Iron deficiency is quite common among people throughout the world. However iron exposure results in siderosis (mottling of lungs)11 Standards of iron[9] in drinking water is 0.3ppm. In the present studies the concentrations of Fe varied from ND to 0.21ppm. Long term consumption of drinking water with high concentration of iron may lead to liver diseases.

Manganese (Mn)
It is one of the most important trace elements essential for organisms. Manganese effects occur mainly in the respiratory tract and in the brains 12. The central nervous system is the chief site of damage from the disease, which may result in permanent disability. Symptoms include languor, sleepiness, weakness, emotional disturbances, recurring leg cramps, and paralysis. Mn is found to vary between ND to 0.082 ppm.

Lead (Pb)
Lead exposure also occurs through gasoline additives, food can solder, ceramic glazes, drinking water system, cosmetics, folk remedies, and battery/plastic recycling industry .The possible health hazard is associated with lead entering feed ingredients from the soil. The toxicity of lead is attributed to the fact that it interferes with the normal function of enzymes. Symptoms include abdominal pain, convulsions, hypertension, renal dysfunction, loss of appetite, fatigue, and sleeplessness. Other symptoms are hallucinations, headache, numbness, arthritis and vertigo[13].The minimum and maximum lead concentrations varied between ND and 0.009 ppm. None of the samples exceeded the relevant prescribed limits for lead in drinking water.

Zinc (Zn)
Zinc is an essential nutrient that plays an important role in brain development, learning and memory, among many other basic processes in the body. Zinc can come from

natural sources, and acidic water tends to leach it out of rocks. Zinc also gets into the environment from worn down tires on roads, mining and industrial processes. Too much amounts of zinc are toxic[6], and there is no huge difference between recommended amounts and excessive amounts. The recommended daily intake is 8 milligrams per day for women and 11 milligrams for men. Zn in the current study ranged between ND to 0.079 ppm.

CONCLUSION

The analysis of ground waters for Al ,Cd, Cr, Fe, Mn, Pb and Zn revealed that all the samples, have very low concentrations of these elements and are suitable for irrigation purposes. It is very much essential to protect groundwater resources in these areas otherwise, it lead to contamination by hazardous and toxic materials from industrial wastes.

Table 1: Trace metal concentration in water samples collected on 10-02-2012

Station No.	Temperature (^{0}C)	pH	Al	Cr	Cd	Fe	Mn	Pb	Zn
S1	26.70	7.60	0 021	0.022	0.060	0.14	0.056	ND	ND
S2	26.72	7.82	0.012	0.047	0.032	ND	0.022	ND	0.029
S3	27.22	7.80	0.056	ND	ND	ND	0.038	0.005	0.023
S4	27.55	7.83	ND	ND	0.022	0.035	0.019	0.009	ND
S5	27.62	7.88	0.037	0.034	0.035	0.12	0.045	0.006	0.025
S6	27.28	7.85	ND	0.041	0.039	0.019	0.026	0.001	0.018
S7	27.34	7.50	0.029	0.046	0.065	0.25	0.035	0.005	0.012
S8	27.22	7.80	0.012	0.034	0.072	0.088	ND	0.007	0.054

ND = Not Detectable : BDL = Below Detectable Limit

Table 2: Trace metal concentration in water samples collected on 11-03-2012

Station No.	Temperature (^{0}C)	pH	Al	Cr	Cd	Fe	Mn	Pb	Zn
S1	27.29	7.45	0.006	0.016	0.061	0.14	0.082	ND	0.019
S2	27.45	7.85	0.021	0.038	0.052	0.024	0.028	0.003	0.025
S3	27.52	7.90	0.078	0.045	0.048	0.035	0.045	0.007	0.035
S4	27.80	7.68	0.014	0.032	0.074	0.062	0.044	0.004	0.021
S5	27.64	7.82	BDL	0.030	0.052	0.17	0.038	0.001	0.009
S6	27.72	7.85	BDL	0.042	ND	0.044	0.032	0.004	0.029
S7	27.39	7.64	0.056	0.046	0.039	0.25	0.002	0.002	0.018
S8	27.55	7.35	0.022	0.038	0.051	0.069	0.036	0.007	0.072

Table 3: Trace metal concentration in water samples collected on 14-04-2012

Station No.	Temperature (^{0}C)	pH	Al	Cr	Cd	Fe	Mn	Pb	Zn
S1	27.19	7.65	BDL	0.033	0.065	0.16	ND	ND	0.019
S2	27.35	7.89	BDL	0.041	0.032	ND	0.018	0.003	0.024
S3	27.68	7.80	0.022	ND	ND	ND	0.068	0.002	0.015
S4	27.60	7.63	0.31	0.041	ND	0.032	ND	0.006	0.041
S5	28.06	7.85	BDL	0.036	ND	0.19	ND	0.003	0.033
S6	28.22	7.82	0.077	0.042	ND	0.089	0.036	0.002	0.022
S7	28.05	8.22	0.059	0.039	0.049	0.27	0.042	0.005	0.014
S8	28.72	8.26	0.017	ND	ND	0.062	0.055	0.002	0.064

Table 4: Trace metal concentration in water samples collected on 11-05-2012

Station No.	Temperature (^{0}C)	pH	Al	Cr	Cd	Fe	Mn	Pb	Zn
S1	27.69	7.55	0.032	0.013	0.061	0.13	ND	ND	0.014
S2	27.55	7.82	0.056	0.052	0.032	ND	0.018	0.002	0.021
S3	28.28	7.90	0.044	ND	ND	ND	0.062	0.004	0.025
S4	27.93	7.73	0.019	ND	0.034	0.044	ND	0.002	0.011
S5	28.12	7.88	BDL	ND	0.022	0.19	0.045	0.006	0.009
S6	27.86	7.62	BDL	0.042	ND	0.039	ND	ND	0.009
S7	28.10	8.02	0.023	0.034	0.049	0.27	0.032	0.005	0.018
S8	28.25	8.11	BDL	ND	ND	0.064	ND	0.003	0.073

Table 5: Trace metal concentration in water samples collected on 10-05-2012

Station No.	Temperature (^{0}C)	pH	Al	Cr	Cd	Fe	Mn	Pb	Zn
S1	27.92	7.62	0.016	0.008	0.055	0.16	0.026	ND	0.004
S2	27.45	7.76	0.012	0.043	0.038	ND	0.012	0.0020	0.011
S3	27.80	7.91	0.056	ND	ND	ND	0.056	0.004	0.032
S4	27.93	7.85	ND	0.036	0.024	0.032	ND	0.002	0.021
S5	29.12	8.05	0.037	ND	0.032	0.21	0.037	ND	0.015
S6	28.73	7.82	ND	0.048	ND	0.035	ND	ND	0.013
S7	29.09	8.06	0.028	0.026	0.042	0.35	0.026	0.052	0.009
S8	28.62	8.12	0.031	ND	ND	0.028	0.021	ND	0.066

Table 6: Trace metal concentration in water samples collected on 11-06-2012

Station No.	Temperature (^{0}C)	pH	Al	Cr	Cd	Fe	Mn	Pb	Zn
S1	27.79	7.55	0.032	0.013	0.055	0.16	0.019	ND	0.008
S2	27.85	7.89	0.056	0.036	0.036	ND	0.020	0.003	0.013
S3	28.20	7.80	0.044	0.019	ND	ND	0.041	ND	0.030
S4	28.11	7.63	0.019	ND	0.027	0.032	ND	0.006	0.011
S5	29.10	7.85	BDL	ND	0.019	0.19	0.035	ND	0.008
S6	28.72	7.82	BDL	0.046	ND	0.039	0.008	ND	0.015
S7	29.02	8.22	0.08	0.038	0.035	0.27	0.032	0.065	0.021
S8	28.94	8.26	0.04	0.019	0.014	0.06	ND	0.008	0.054

REFERENCES

1. Lars Jarup. British Medical Bulletin. 2003;68:167-182.
2. Petrus R and Warchol JK. Water Res. 2005;39:819-830.
3. Lokhande RS and Kelkar N. Indian J Environ Protect. 1999;19:664-668.
4. Lokeshwari H and Chandrappa GT. Curr Sci. 2006;91(5):584.
5. Standard Methods for the examination of water and waste water. APHA. AWWA, WEF, New York 1998, 20th edition.
6. WHO. Guidelines for drinking-water quality, fourth edition. WHO. 2011.
7. WHO, World Health Organization technical report series, Geneva, 1984.
8. Clayton DB (Water pollution at Lower moore North Cornwall: Report of the Lower moore incident health advisory committee. Truro, Cornwall District Health Authority, 1989:22.
9. BIS, Indian Standards Drinking Water specifications. Bureau of Indian Standard. 1991:10500.
10. US Environmental Protection Agency (EPA). EPA's Terms of Environment. U.S. Environmental Protection Agency. 2000.
11. SullivanJ L. The iron paradigm of ischemic heart disease. Amer Heart J. 1989:1177-1187.
12. Barik RN, Pradhan B Patel and RK. Trace elements in ground water of Paradip area J Ind poll control. 2005;21(2):55-362.
13. Niazi ALT, Isfahari M and Ahmasi ZJ. J Hazard Mat. 2009;165:1200.