Research Journal of Chemical Sciences _____ ISSN 2231-606X
Vol. **6(1),** 8-11, January **(2016)** *Res. J. Chem. Sci.*

Assessment of Trace Elements of Sewage and Well Water of Ahmednagar City, MS, India

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Available online at: www.isca.in, www.isca.me
Received 30th Augustr 2015, revised 24th September 2015, accepted 12th November 2015

Abstract

The aim of the present investigation is to assess the trace element concentration of sewage and well water of Ahmednagar (Maharashatra) city was done. The collection of samples was done from different localities of the city during the year 2013. The samples were analysed for trace elements like Fe, Mn, Zn, Cu, B, Cd, Cr, Ni, As and F using AAS. The results of study show that all the study elements are more than reference range of water quality for irrigaton.

Keywords: Sewage water, Trace elements, Irrigation.

Introduction

Existing water sources fall short in satisfying the needs of increasing global population. Use of Sewage water for irrigation purpose is one of the remedies to overcome this shortage of water. Extensive literature survey shows that sewage water has agronomic value because of its varied composition. Due to the nutrients present in it, sewage water s widely used for irrigation purpose.

Continuous irrigation with sewage may result in accumulation of heavy metals to severely toxic level in soil[1-6]. Plants and vegetables which are part of human diet can absorb these accumulated heavy metals from water and soil[7-10]. This can lead to long term toxic effects on human health as metals are non-degradable. Fresh water reservoirs are also reported to be contaminated with trace elements[11-14].

Some trace elements (density 6 gcc^{-1}) are essential for life processes but all are toxic to organisms at their higher concentrations. Uptake of excess heavy metals by higher plants can modulate or initiate a diverse metabolic changes leading to global phytotoxic response. Heavy metals can alter the metabolic process which can be toxic to human health.

Being a very rapidly growing city, Ahmednagar is much more dependent on sewage water for irrigation especially for vegetables at Delhi gate and Sarasnagar area of the city. This area is mainly using this sewage water as a source of irrigation since 1972 and growing vegetable crops like cauliflower, cabbage and brinjal. Owing to this fact there is increasing risk of accumulation of heavy metals in soils as well as crops at toxic levels.

In present study, trace element analysis of sewage and well water of Ahmednagar city has been carried out.

Materials and Methods

Collection of sewage water and well water samples: Total 6 sewage 11 well water samples were collected from the fields where this water is used for cultivation of vegetables at Delhi gate and Sarasnagar area of Ahmednagar city.

Trace Element Analysis: Trace elements like Fe, Mn, Zn, Cu, B Cd, Cr, Ni were estimated using atomic absorption spectral method.

Results and Discussion

In the present investigation, the characteristic properties of sewage water which is being used for irrigation to vegetable crops in the adjoining areas of Sina river of Ahmednagar city were studied. The results of the study are summarized in table.

Trace elements: The concentration of Fe in sewage water varied from 4.890 to 7.320 mgL^{-1}, Mn from 0.494 to1.235 mgL^{-1}, Zn from 0.753 to 2.100 mgL^{-1} , Cu from 0.064 to 0.230 mgL^{-1} , and B from 2.231 to 5.840 mgL^{-1} . Most of these values are higher as compared to the recommended maximum concentration of these elements for waste water use in agriculture as suggested by FAO[10].

The concentration of these essential plant nutrients is considerably higher in the city effluents including that they are the good source of these micronutrients and may help in mitigating their emerging problems of deficiency in soils which otherwise are usually overcome by application of costly chemical fertilizers. However, their high concentrations beyond permissible limits warrants the potential hazard to soil and plant health suggesting necessity of their sage use after pretreatments in order to utilize this resource in agriculture.

Table-1
Trace Element concentration of Sewage water

Parameter	Delhi gate 1	Delhi gate 2	Delhi gate 3	Delhi gate 4	Sarasnagar -1	Sarasnagar -2
Fe mgL^{-1}	5.240	5.870	7.320	4.890	5.090	4.910
Mn mgL^{-1}	0.926	0.494	0.850	1.219	0.956	1.235
Zn mgL^{-1}	1.792	1.570	2.100	0.954	1.720	0.753
Cu mgL^{-1}	0.238	1.230	0.100	0.232	0.064	0.254
B mgL^{-1}	4.747	2.521	2.885	4.978	2.231	5.840
Cd mgL^{-1}	0.262	0.121	0.342	0.098	0.278	0.092
Cr mgL^{-1}	0.987	1.422	1.788	0.175	0.718	0.299
Ni mgL^{-1}	0.922	0.326	0.895	0.625	0.700	0.451
AS mgL^{-1}	1.560	1.512	1.692	0.010	0.932	0.009
F mgL^{-1}	0.95	0.82	0.81	0.95	0.87	0.83

Table-2
Trace Element Concentration of well water (D = Delhi Gate)

Parameter	D 1	D 2	D 3	D 4	D 5	S -1	S -2	Nepti 1	Nepti 2	Nepti 3	Nagapur 1
Trace elements											
Fe mgL^{-1}	5.516	2.412	0.375	0.165	0.183	5.336	0.099	0.230	0.149	0.078	0.294
Mn mgL^{-1}	0.423	1.203	1.202	0.973	0.762	0.762	0.436	0.315	0.147	0.787	0.166
Zn mgL^{-1}	1.510	0.415	0.445	0.421	0.341	0.812	0.415	0.297	0.391	0.281	0.443
Cu mgL^{-1}	0.069	0.122	0.121	0.096	0.086	0.065	0.088	0.074	0.054	0.020	0.093
B mgL^{-1}	1.819	2.865	2.353	1.768	2.323	1.822	2.340	1.710	1.988	1.945	1.930
Cd mgL^{-1}	0.190	0.012	0.015	0.009	0.075	0.260	0.009	0.007	0.006	0.009	0.006
Cr mgL^{-1}	1.712	0.155	0.085	0.091	0.045	0.074	0.076	0.056	0.099	0.053	0.093
Ni mgL^{-1}	0.511	0.385	0.354	0.356	0.452	0.295	0.265	0.298	0.243	0.266	0.490
AS mgL^{-1}	0.060	0.043	0.025	0.019	0.026	0.009	0.008	0.009	0.009	0.008	0.005
F mgL^{-1}	0.70	0.92	0.85	0.77	0.28	0.63	0.66	0.81	0.56	0.67	0.58

Table-3
Average composition of sewage and well water

Parameter	Sewage Water		Well Water	
	Range	Mean	Range	Mean
Fe, mgL^{-1}	4.890-7.320	6.10	0.078-5.516	2.80
Mn, mgL^{-1}	0.494-1.235	0.86	0.147-1.203	0.68
Zn, mgL^{-1}	0.753-2.100	1.43	0.281-1.510	0.90
Cu, mgL^{-1}	0.064-1.230	0.65	0.02-0.122	0.07
B, mgL^{-1}	2.231-5.840	4.04	1.710-2.865	2.29
Cd, mgL^{-1}	0.092-0.342	0.22	0.006-0.190	0.09
Cr, mgL^{-1}	0.175-1.788	0.98	0.045-1.712	0.88
Ni, mgL^{-1}	0.326-0.922	0.62	0.2430-0.511	0.75
As, mgL^{-1}	0.009-1.692	0.85	0.005-0.060	0.03
F, mgL^{-1}	0.81-0.95	0.88	0.28-0.92	0.6

Table-4
Recommended water quality guidelines

Parameter	Recommended maximum concentration
Fe, mgL^{-1}	5
Mn, mgL^{-1}	0.2
Zn, mgL^{-1}	2
Cu, mgL^{-1}	0.2
B, mgL^{-1}	2
Cd, mgL^{-1}	0.01
Cr, mgL^{-1}	0.1
Ni, mgL^{-1}	0.2
As, mgL^{-1}	0.1
F, mgL^{-1}	1.0

The concentration of Cd in sewage water varied from 0.092 to 0.0.342 mgL^{-1} , Cr from 0.175 t 1.788 mgL^{-1} , Ni from 0.326 to 0..922 mgL^{-1} , As from 0.009 to 1.692 mgL^{-1} . Most of these values excepting F are higher as compared to the recommended maximum concentration for waste water use in agriculture as suggested by FAO.

The concentration of Fe in well water ranged from 0.078 to 5.516 mgL^{-1}, Mn from 0.147 to 1.203 mgL^{-1}, Zn from 0.281 to 1.510 mgL^{-1}, Cu from 0.02 to 0.122 mgL^{-1}, B from 1.710 to 2.865 mgL^{-} . The concentration of Cd in well water varied from 0.006 to 0.190 mgL^{-1} , Cr from 0.045 to 1.712 mgL^{-1}, Ni from 0.243 to 0.511 mgL^{-1} , As from 0.005 to 0.060 mgL^{-1} and F from 0.28 to 0.92 mgL^{-1} . The concentration of trace elements was found to be higher only in the wells in the nearer vicinity of the Sina river indicating contamination of ground water with heavy metals which is also potentially toxic and restricts the use of this water for irrigation. The concentration of fluoride although lower than the permissible limit the value is approaching the limit and the continuous use of this water may have potential toxicity and the ground water may likely be contaminated in the long run. The considerably higher concentrations of heavy metals Cd, Cr, Ni and As in the sewage water beyond the permissible limit indicates that the long term use of this water as a source of irrigation may lead to contamination of soil by these metals which are potentially toxic for human and animal health.

Conclusion

The city sewage water although being increasingly used for irrigation agriculture crops because of its nutrient content and organic matter, its use on long term basis may contaminate the soils and plants by heavy metal accumulation and thus necessitates studies on impact of its use on soils and plants.

The concentration of Fe, Mn, Zn, Cu and B was higher in sewage water as compared with guidelines for water quality for

respect of Cd, Cr, Ni, As was also higher than the maximum recommended concentration for waste water use in agriculture as suggested by FAO[10]. The concentration of these heavy metals was however, appreciably lower in well water. The higher concentrations of heavy metals in sewage water observed may likely to create problems of phytotoxicity and food contamination.

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