

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 5, Issue 12, December 2016

Comparative Study of Physico-Chemical Parameter and Some Heavy Metals in Ground Water in Saline Track of Buldana District

B. M. Tayde¹, B. B. Wankhade²

Assistant Professor, Department of Applied Science, Padm. Dr. V. B. Kolte College of Engineering, Malkapur,
Maharashtra, India¹

Principal, Department of Chemistry, Vidnyan Mahavidyalaya, Malkapur, Maharashtra, India²

ABSTRACT: Water is precious and necessary for a sustainable economic development of an area as it is the next major support to life after air. Drinking water quality is a common concern for people all over the world. Ground water polluted by heavy metals becomes an environmental problem, though the metals are constituent of nature. Water softening methods such as lime soda & ion exchange are effective for removal of heavy metals. In lime soda method the soluble calcium, magnesium and heavy metals in in water are chemically converted in to insoluble compound by adding calculated amount of lime $[\text{Ca}(\text{OH})_2]$ and soda $[\text{Na}_2\text{CO}_3]$. Today ion exchange membranes are receiving considerable attention and are successfully applied for desalination of seawater and removal of heavy metals from water. In the present work ground water samples were collected from different villages of Purna river basin. Samples were analysed for physico-chemical parameters such as temperature, pH, TDS, Hardness, Conductivity, Turbidity, Alkalinity and heavy metals like Cu, Fe, Cd, Pb, Cr, Ni, and Zn. Heavy metals are assessed before and after Lime soda and Ion exchange treatment. The result of the study reveals that TDS, Hardness and heavy metal concentration of metal ions are reduced significantly after treatment.

KEYWORDS : Ground water, Physico-chemical parameter, Lime Soda, Ion Exchange, Heavy metals.

I. INTRODUCTION

The quality of water is vital concern for mankind because it directly linked with human health. [1]. Ground water has been traditionally considered to be pure form of water because of its filtration through soil and its long residence time on the ground. However, groundwater is not as pure as traditionally assumed [2]. Pollution of aquatic environments by heavy metals is one of the major threats to the water resources of the world today. Heavy metal pollutants are of concern because their non-degradability creates a hazard when discharged into a water body [3]. Heavy metals are also known to be toxic to both humans and other living forms, with their accumulation over time causing damage to the kidney, liver and reproductive system in addition to cancer [4]. During last few years, it is reported that the patients affected by water pollutants are facing serious health problems like kidney failure, hair loss and cardiovascular damage. If the population use untested and untreated water for drinking this could be probably the cause of so many water borne diseases [5]. Thus, methods of remediation of groundwater and treating industrial wastewater to avoid further contamination of groundwater are required. [6] Many techniques have been used to remove dissolved heavy metals. These include precipitation [7], ultrafiltration [8], reverse osmosis [9], and electro dialysis [10]. In the present work the ion exchange process (IEP) and lime soda process (LSP) were used for the remediation of presence of metal ions in contaminated water.

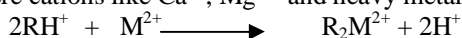
International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

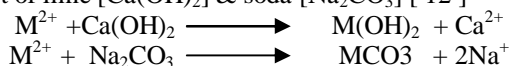
Vol. 5, Issue 12, December 2016

II. MATERIAL AND METHOD

The presence of metal ions in contaminated water can be removed by ion exchange process. Ion exchange resins are insoluble, cross-linked, long chain organic polymer with a micro porous structure and the functional group attached to the chain responsible for the ion-exchange properties. Resin containing acidic functional group (-COOH, -SO₃H etc.) are capable of exchanging H⁺ ions with other cation present in moving water phase. The contaminated water is passed through cation exchange column, where cations like Ca²⁺, Mg²⁺ and heavy metal ions are removed from water.[11]



In Lime Soda Process, the soluble metal salts in contaminated water are chemically converted into insoluble compounds by adding calculated amount of lime [Ca(OH)₂] & soda [Na₂CO₃] [12]



Sampling:

Samplings of ground water were done by standard methods [13]. Sampling was done in summer season in the month of May 2016. Nine villages where kidney failure patients are reported and the main source of drinking water is ground water were selected as target area. Those villages are Khandavi, Jalgaon, Borada, Yerali, Changefal, Nirod, Niwana, Panhera and Zodaga of Buldana District. The parameters were determined at research laboratory and metal ion at Central Instrumentation Cell S.G.B. Amravati University Amravati.

Table 1 [Methods employed for determination Of Physico-chemical parameters]

Sr. No	Parameters	Methods employed
01	pH	pH metry
03	TDS	TDS meter
04	Hardness	EDTA Titration
05	Conductivity	Conductometry
06	Metal Ions	Atomic Absorption Spectrophotometry(AAS)
07	alkalinity	Titration
08	Turbidity	Turbidity meter

Table 2 ISI (Indian Standard Institute), ICMR (Indian Council of Medical Research), WHO (World Health Organization)

Water Parameters	ISI	ICMR	European	WHO
pH	6.5-8.5	6.5-8.5	6.5-8.5	6.5-9.2
TDS	500-2000	500-1500	500	500
Hardness	600	300	500	500
Conductivity	--	300	400	300

III.RESULTS AND DISCUSSION

The ground water sample were analysed for various parameter like Temperature, pH, TDS, Hardness, conductivity, Turbidity, Alkalinity and dissolve metal ion [14]. TDS was determined by TDS meter before and after LSP & IEP process. Hardness of water is caused by presence of Ca, Mg and other heavy metals. Hardness determination is very important as far as metal concentration concern. The total hardness of water was determined by EDTA method. pH of the solution was determined by pH meter, Equip-tronics, model no. 610. Electrical conductivity was measure by conductivity meter, Equip-tronics, model no. 660A. Alkalinity determined by titration and turbidity determine by turbidity meter. The chemicals used were of AR grade Utmost care were taken during sampling to avoid any kind of contamination. Temperature and pH were measured at the time of sampling itself. Metal ion determined by Atomic Absorption Spectrophotometry [5].

Methods employed for determination of physic-chemical parameters are given in the Table 1.The standard limits of water quality parameters in drinking water prescribed by ISI, ICMR, European and WHO are shown in the table 2.

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 5, Issue 12, December 2016

S.N	Temp (°C)	pH	TDS (mg/l)	Conductivity (Mho/cm)	Turbidity (NTU)	Alkalinity (PPM)	Hardness (PPM)
1	36	7.30	716	1.98	7.2	26	803
2	35	7.29	974	2.77	21.8	286	1010
3	34	7.47	1890	6.54	26.3	221	1713
4	35	7.33	1780	5.46	35.9	598	920
5	36	7.76	971	2.70	16.9	658	350
6	32	7.14	644	1.66	17.5	247	610
7	35	7.65	388	0.94	29.3	221	350
8	35	7.45	937	2.55	10.2	156	837
9	36	7.44	567	1.40	11.0	325	420

Table 3: Physico-chemical parameters of ground water samples of Purna river basin before treatment.

S.N	Temp (°C)	pH	TDS (mg/l)	Conductivity (Mho/cm)	Turbidity (NTU)	Alkalinity (PPM)	Hardness (PPM)
1	32	10.65	806	1.83	5.5	156	430
2	31	11.61	1370	3.29	5.6	286	590
3	31	12.2	3140	8.29	5.4	312	1120
4	31	11.15	2040	4.90	12.8	429	180
5	30	11.08	1260	2.79	10.3	455	40
6	31	11.58	926	1.99	6.3	195	300
7	31	11.74	685	1.44	3.5	182	200
8	30	11.89	1470	3.28	4.2	221	760
9	31	11.92	929	1.93	6.6	234	290

Table 4: Physico-chemical parameters of ground water samples of Purna river basin after Lime soda treatment.

S. N	Temp (°C)	pH	TDS (mg/l)	Conductivity (Mho/cm)	Turbidity (NTU)	Alkalinity (PPM)	Hardness (PPM)
1	29	8.55	526	1.29	8.5	250	410
2	29	8.90	817	1.94	7.8	375	640
3	29	8.53	1800	5.29	6.8	325	340
4	29	9.38	1680	4.69	6.3	375	810
5	29	9.20	1110	2.74	6.4	300	330
6	29	9.17	576	1.33	4.8	200	520
7	29	8.85	735	1.72	5.8	250	340
8	29	9.21	576	1.34	5.8	225	400
9	29	9.34	445	1.00	4.4	250	300

Table 5: Physico-chemical parameters of groundwatersamples of Purna river basin after Ion exchange treatment.

The results of the present study are tabulated in table number 3-8. Physico-chemical parameters like Temperature, pH, TDS, Total hardness, electrical conductivity, turbidity, alkalinity and metal ion content are important in assessing the water quality and finding its suitability for drinking purpose [15]. It was observed that the temperature variations at all

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 5, Issue 12, December 2016

sites are nearly uniform for all samples. pH of all samples were risen to 11 for LSP and up to 9 for IEP. It may be attributed to the addition of Na⁺ and OH⁻ ions in IEP and lime in LSP The hardness of some water samples were beyond the permissible limit but it was decreases to certain level after lime soda and ion exchange treatment. Conductivity and alkalinity of some water samples were increases after treatment but the turbidity of all samples decreases. The results are tabulated in Table 3, 4, 5 and are compared with water quality standards given by WHO and other agencies. The concentration of heavy metal such as Cu, Fe, Cd, Pb, Mn, Zn, Cr & Ni mg/l in the groundwater sample S1 to S9 were assessed before and after LSP and IEP. From the result it is reveals that the concentration of heavy metal in ground water reduces to certain level after the treatment of lime soda and ion exchange process, but at the same time some physico-chemical parameters like pH, Conductivity Alkalinity shows variation with increase in value

S.N.	Element	Process	S-1	S-2	S-3	S-4	Se-5	S-6	S-7	S-8	S-9	WHO Guideline
1	Cu	BT	0.125	0.132	0.151	0.129	0.136	0.139	0.135	0.14	0.126	2mg/dm ³
		ALSP	0.116	0.119	0.124	0.113	0.121	0.116	0.117	0.121	0.111	
		AIEP	0.112	0.115	0.12	0.109	0.115	0.111	0.113	0.116	0.108	
2	Fe	BT	0.18	0.164	0.151	0.204	0.171	0.193	0.168	0.175	0.149	50mg/dm ³
		ALSP	0.165	0.141	0.0139	0.187	0.152	0.164	0.148	0.156	0.132	
		AIEP	0.133	0.121	0.119	0.168	0.144	0.159	0.142	0.149	0.123	
3	Cd	BT	0.049	0.052	0.048	0.040	0.048	0.042	0.046	0.038	0.053	0.003 mg/dm ³
		ALSP	0.029	0.036	0.034	0.026	0.032	0.026	0.037	0.032	0.039	
		AIEP	0.019	0.021	0.025	0.019	0.024	0.020	0.021	0.023	0.025	
4	Pb	BT	0.061	0.069	0.074	0.07	0.059	0.063	0.056	0.061	0.059	0.01 mg/dm ³
		ALSP	0.042	0.046	0.051	0.049	0.037	0.041	0.039	0.045	0.046	
		AIEP	0.031	0.031	0.046	0.04	0.031	0.036	0.032	0.04	0.041	
5	Mn	BT	0.039	0.041	0.032	0.036	0.052	0.046	0.035	0.041	0.056	0.4 mg/dm ³
		ALSP	0.021	0.036	0.017	0.024	0.039	0.029	0.019	0.026	0.038	
		AIEP	0.014	0.025	0.011	0.016	0.024	0.021	0.011	0.022	0.032	
6	Zn	BT	0.024	0.049	0.056	0.029	0.032	0.026	0.032	0.039	0.047	0.01-0.05 mg/dm ³
		ALSP	0.017	0.032	0.039	0.016	0.019	0.012	0.015	0.032	0.034	
		AIEP	0.013	0.024	0.033	0.012	0.016	0.008	0.01	0.015	0.028	
7	Cr	BT	0.052	0.049	0.046	0.038	0.048	0.044	0.042	0.034	0.056	0.05 mg/dm ³
		ALSP	0.039	0.026	0.031	0.025	0.032	0.026	0.035	0.028	0.029	
		AIEP	0.028	0.021	0.024	0.019	0.029	0.021	0.024	0.021	0.023	
8	Ni	BT	0.056	0.065	0.049	0.04	0.072	0.068	0.058	0.073	0.044	0.07 mg/dm ³
		ALSP	0.041	0.053	0.032	0.026	0.059	0.043	0.047	0.051	0.035	
		AIEP	0.036	0.041	0.028	0.021	0.052	0.038	0.041	0.046	0.029	

Table: 6 AAS analysis of water sample for heavy metal before treatment (BT), after Lime soda process (LSP) and ion exchange process (IEP)

The results of the analysis of the heavy metals in the water samples are presented in table 6, 7 and 8.

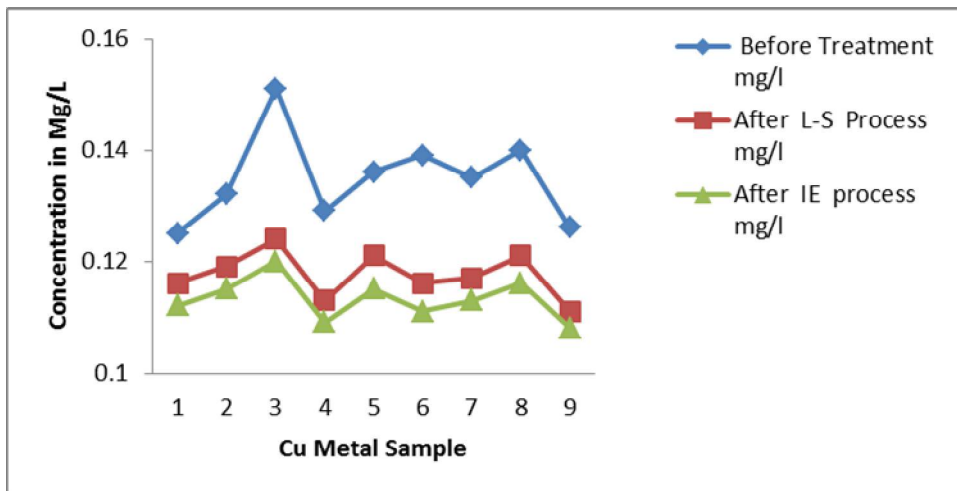
International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 5, Issue 12, December 2016

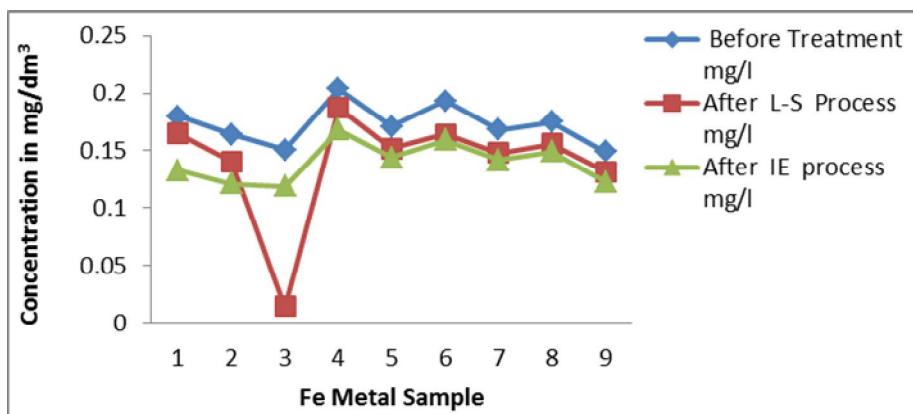
Copper (Cu):

Copper is both an essential nutrient and a drinking-water contaminant [16]. In the present study concentrations of copper are well below the WHO Guidelines for drinking water quality. Measured values are shown in table 6, 7 and 8. The comparison levels of Copper before and after lime soda and ion exchange treatment is shown in Graph- I.



Iron (Fe):

Iron is an essential element in human nutrition, particularly in the iron (II) oxidation state. Estimates of the minimum daily requirement for iron depend on age, sex, physiological status and iron bioavailability and range from about 10 to 50 mg/day [16]. In the present study concentrations of Iron are well below the WHO Guidelines for drinking water quality. Measured values shows in table 6, 7 and 8. The comparison levels of Copper before and after LSP and IEP is shown in Graph- II.



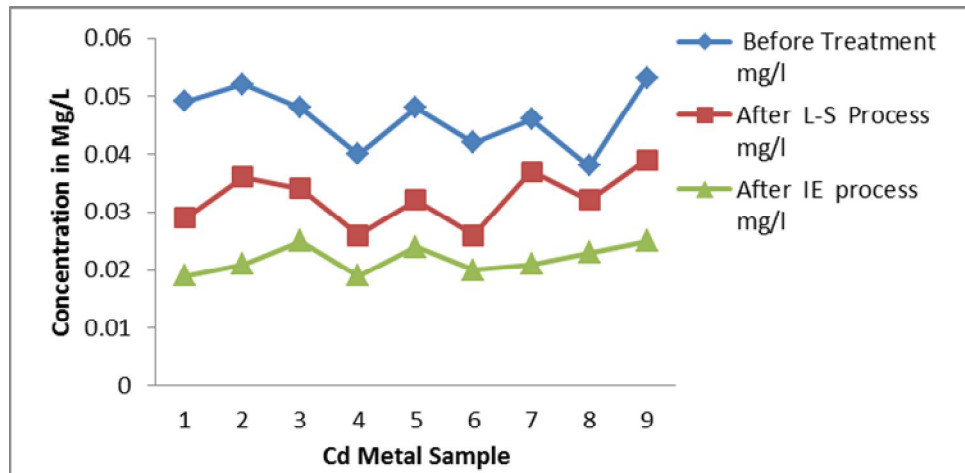
Cadmium (Cd):

Cadmium is released to the environment in wastewater, and pollution caused by contamination from fertilizers [16].The permissible limit for cadmium in Drinking water no exceed than 0.003Mg/L as per WHO guideline. In the present work it is observed that the concentration of Cadmium is beyond the WHO guideline for all samples. The measured values are shown in table 6,7and 8. It is observed that after LSP and IEP concentration of Cadmium is decreases as shown in Graph- III.

International Journal of Innovative Research in Science, Engineering and Technology

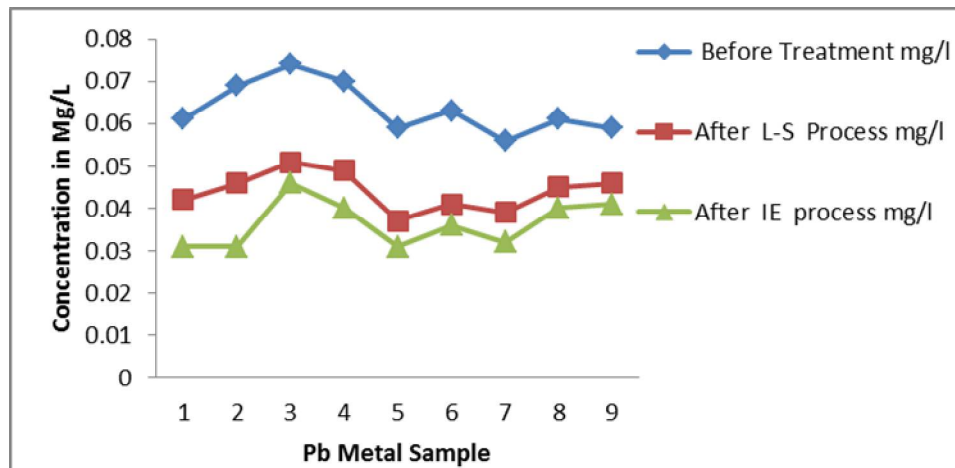
(An ISO 3297: 2007 Certified Organization)

Vol. 5, Issue 12, December 2016



Lead (Pb):

Lead is common heavy metal found in industrial effluent, particularly in developing countries. The main source of Lead are mining and smelting activities. Lead is toxic to many organs of human body including heart and kidneys, reproductive and nervous system [17]. The permissible limit of Lead in Drinking water is 0.01Mg/L as per WHO guideline. In the present work it is observed that the concentration of Cadmium is beyond the WHO guideline for all samples. The measured values shows in table 6,7and 8. From the graph it reveals that after LSP and IEP concentration of Lead is decreases which are shown in Graph- IV.



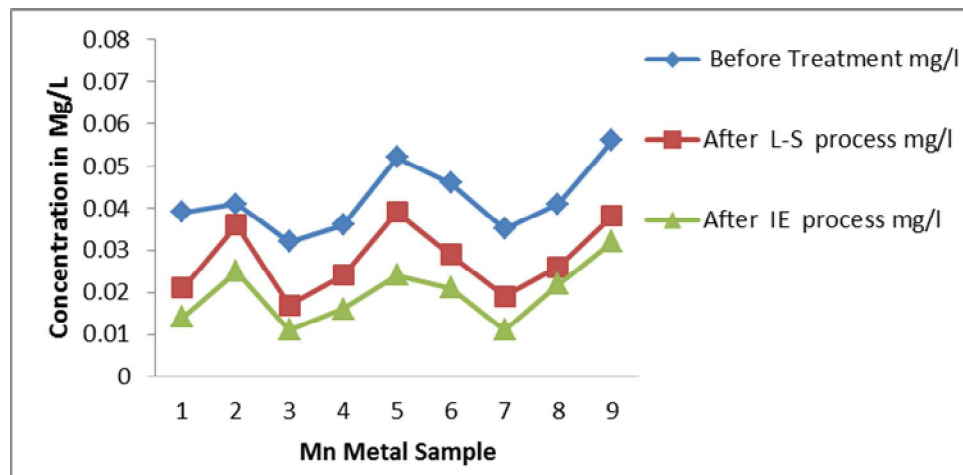
Manganese (Mn):

Manganese is naturally occurring in many surface water and groundwater sources, as per WHO guideline the permissible of Lead in drinking water is 0.4mg/l.[16] In the present study concentrations of Manganese are below the WHO Guidelines for drinking water quality. Measured values shows in table 6,7and 8. The comparison levels of Manganese before and after LSP and IEP is shown in Graph- V.

International Journal of Innovative Research in Science, Engineering and Technology

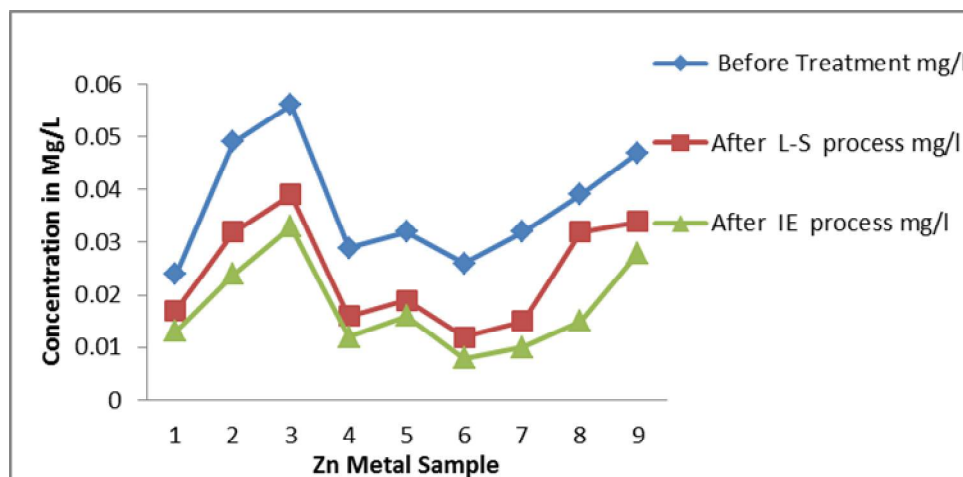
(An ISO 3297: 2007 Certified Organization)

Vol. 5, Issue 12, December 2016



Zinc (Zn):

Zinc is an essential trace element found in virtually all food and potable water in the form of salts or organic complexes. Although levels of zinc in surface water and groundwater normally do not exceed 0.01 to 0.05 mg/l, respectively [16]. In the present study concentrations of Zinc are below the WHO Guidelines for drinking water quality for all samples. Measured values shows in table 6,7and 8. From the graph it is observed that concentration of Zinc decreases after LSP and IEP as shown in Graph-VI.



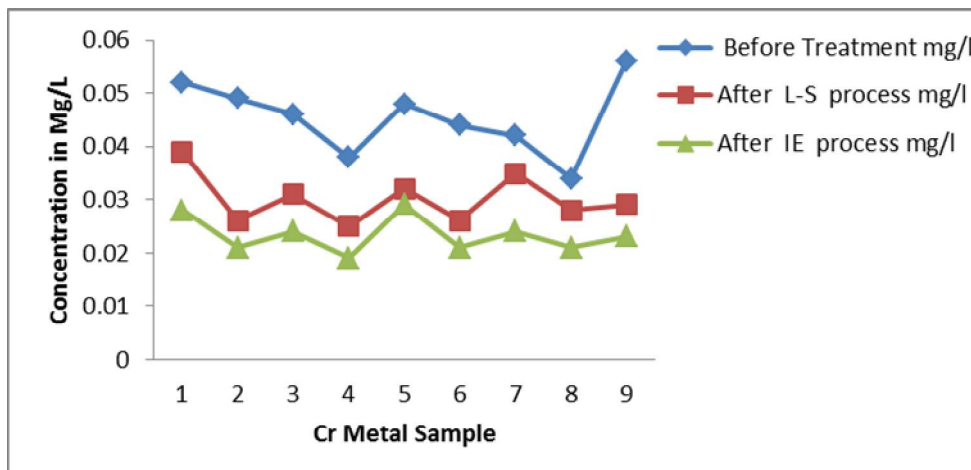
Chromium(Cr):

The maximum allowable limit for chromium as per WHO guidelines is 0.05 mg/L. Chromium concentration levels in all studied samples were below then WHO Standards [16]. The concentration levels of chromium in all the samples are shown in table 6,7and 8. The comparison levels of Chromium before and after LSP and IEP are shown in Graph- VII.

International Journal of Innovative Research in Science, Engineering and Technology

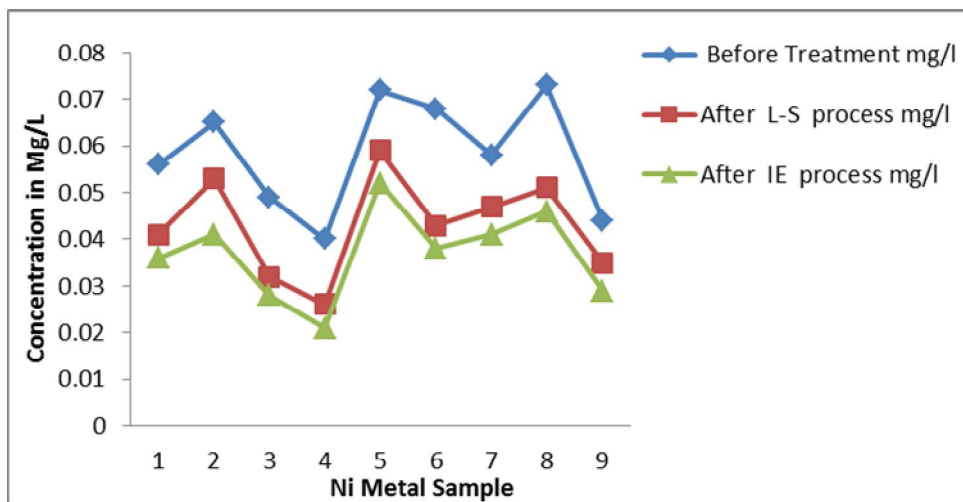
(An ISO 3297: 2007 Certified Organization)

Vol. 5, Issue 12, December 2016



Nickel (Ni):

The maximum allowable limit for chromium as per WHO guidelines is 0.07mg/L. Concentration levels of Nickel in all studied samples were below then WHO Standards. The concentration levels of Nickel in all the samples are shown in table 6,7 and 8. The comparison levels of Nickel before and after LSP and IEP are shown in Graph- VIII.



IV. CONCLUSION

The results obtained for the various parameters shows that pH, Temperature and Conductivity value are well within the permissible limit. TDS, Hardness, Turbidity and Alkalinity of some samples beyond the limits. Heavy metals like Cd, Pb exceed than WHO limit for all samples. From the result it is clear that pH conductivity and temperature of all samples are within limit. Heavy metals except Cd and Pb are also within permissible limit. From the result after treatment it is clear that the contamination of heavy metal decreases up to certain level. Cd level decreases below permissible limits, at the same time pH, conductivity and alkalinity in all samples increases. Further it is clear that IEP is more effective than LSP to remove heavy metal ions.

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 5, Issue 12, December 2016

REFERENCES

- [1] A M Kalwale, P A Savale Advances in Applied Science Research, 3 (1):273-279, **2012**
- [2] O. M. Collins & U. Ugbune ,Sky Journal of Soil Science and Environmental Management, Vol 2(3), pp31-33, **2013**.
- [3] M Thayaparan, S.S Iqbal, P K D Chathuranga & M C M Iqbal, international journal of environmental sciences, Vol 3 (6), **2013**.
- [4] Hussain A Z & Sheriff K M M, Journal of Chemical and Pharmaceutical Research, Vol 5(3), **2013**, pp73-77.
- [5] B. M. Tayde and B. B. Wankhade Indian Research Transaction Vol.5, No.2 Apr- Jun 2015
- [6] H. E OMAR, M. A TAREK, and E E HANI Proceedings of the 6th WSEAS Int. Conference on Environment, Ecosystems And Development (EED'08)
- [7] M. M. Matlock, K. R. Henke, and D. A Atwood, J. Hazard. Mater. 92, 129-142, **2002**.
- [8] P. Canizares, Á. Pérez, and R. Camarillo, Desalination 144, 279-285, **2002**.
- [9] H. Ozaki, K. Sharma, and W. Saktayuin, Desalination 144, 287-294, **2002**.
- [10] K. L. Gering and J. F. Scamehorn, Separation Science and Technology 23, 2231- 226 (1988).
- [11] Jain P C & Jain M, Engineering Chemistry, 15th Edition, Phantat Rai publishing company, **2010**.
- [12] Dara S S & Umare S S, Engineering Chemistry, 12th Edition, S Chand Publication and company Ltd, **2010**.
- [13] D. Franceska, National Field Manual for the Collection of Water-Quality Data - chapter A4, U.S. Geological Survey TWRI, Book 9, 2006.
- [14] S. S. Dara, Experiments & Calculation Engineering Chemistry, S Chand Publication and company Ltd, **2011**.
- [15] P. Trivedi, A. Bajpai & S. Thareja, Nature and Science, , 1(6), 91, **2009**.
- [16] World Health Organisation Guidelines for drinking-water quality – 4 edition, **2011**
- [17] V. Hanuman Reddy, P. M. N. Prasad, A. V. Ramana Reddy and Y. V. Rami Reddy Scholars Research Library, Der Pharma Chemica, , 4(6), pp2442-2448, **2012**