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RESEARCH ARTICLE

HEAVY METAL CONTENT OF WATER RESOURCES AFTER GANAPATI IMMERSION IN A SPECIFIED REGION AND ITS PHYSICO CHEMICAL EFECTS ON WATER

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Abstract: The main objective of present study was to assess physicochemical parameters in different water samples in various parts of Nalasopara region. For this 7 different water samples are collected from 4 sampling sites in Nalasopara region, to determine the various physicochemical properties on seasonal basis. In India the major source of water used to meet the domestic, agricultural and industrial needs is the ground water. The situation is aggravated by the problem of water pollution or contamination. The main goal of the present study was to assess heavy metal ions pollution in sea and pond water before and after Ganesh immersion. For this 4 different water samples are collected from sampling sites in Nalasopara town which is a part of Vasai Taluka of Mumbai suburb. Out of the four sites three are sea water samples collected on both high and low tides & one is pond water sample. Some of the heavy metals like Cd, Cu, Cr, Pb, Fe, Zn, Mn, Hg, and Ni were detected using highly sensitive ICP-AES instrument. The heavy metals were found to be in the permissible limits but Cr and Cd were not detected. The results obtained are compared with World health organization (WHO), Indian Standards (IS), European Standards and Beaureau of Indian Standards (BIS-10500:1991). The effect of presence of heavy metals on the physical-chemical parameters of water have been studied at different time intervals individually and in presence of each other.

Keywords: Nalasopara, Vasai Taluka physicochemical, salinity, turbidity.

Introduction:

Trace metals are elements such as chromium, cobalt, copper, iron, magnesium, selenium, and zinc that normally occur at very low levels in the environment. Living things need very small amounts of some trace metals, but high levels of these same metals can be toxic. For example, iron is an essential element for many living things. In human blood, iron transports oxygen around the body. If too much iron is consumed, however, there can be negative effects on human health.

Levels of trace metals in the environment increase when they are released from rocks. These releases can occur through natural processes or through human activities. Natural processes include breakdown of rocks, spreading of mid-ocean ridges, and volcanic activity. Natural sources of metals can be very important. Human activities that release trace metals into the environment include mining, smelting, burning of coal, and wastewater disposal. The tar sands and diamond and metal mining can release trace metals into the surrounding environment. This often occurs when contaminated waste is not properly disposed of or when a lot of dust from the mine site blows around. For the most part, human contributions of trace metals to the environment have been approaching, or even exceeding, natural inputs.

It is often difficult to determine how toxic a trace metal is. Toxicity depends not only on the level of the trace metal in the environment, but also where it is found in the environment (water, soil or air), the source (mining or natural rock breakdown), how acidic the environment is in the area of interest (trace metals are more of a problem in acidic areas), and whether the metal exists by itself or as part of larger chemical compounds. In the North, we are most often concerned about trace metals in areas with mining, especially when there are old, abandoned mines with tailings that have leaked into lakes or streams. At the time that many of these older mines were operating, there were not many regulations about how to store and discharge tailings, so there was often pollution of local lakes and streams. Because these lakes and streams have often also become acidic due to the mine pollution, trace metals can become a problem and have toxic effects on local fish and bugs [1].

The trace elements include more than 60 substances that are usually present in low concentrations in the environment and mammalian tissues. They are generally present in tissue and serum in picogram or microgram amounts, and their absorption, distribution, storage and excretion are tightly controlled. At least a dozen of them are considered essential minerals in humans. The trace elements and most metals are usually present in adequate amounts in the diet and environment, and supplementation is generally not needed. An exception to this is iron [2].

In the present study our main goal of was to assess heavy metal ions pollution in ground water before and after Ganesh immersion. Also how much heavy metals can affect the physico-chemical parameters of water have been studied at different time intervals individually and in presence of each other.

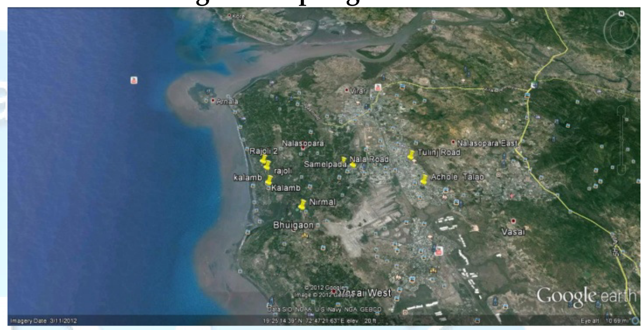
MATERIALS AND METHODS

The present study is in sea and pond water samples before and after Ganesh immersion. Samples were collected before immersion i.e. in the month of July in pre-washed polyethylene bottles. Grab method of collection was used for collecting water samples. pH and temperature were measured on site. The collection and preservation of samples were as per the Standard methods as per APHA [11].Similar way sampling is also done after around twenty days after Ganesh Immersion i.e. Anant Chaturdarshi.

Study Area: Samples were collected from Nalasopara (NSP)town which is a part of Vasai Taluka, in Thane district, Mumbai. The town lies in 19.4154 latitude and 72.8613 longitude.[2] The 3 samples collected from sea water were at a distance of 2 km each i.e., starting from Karam beach (S 1a, S 1b*) to Rajowdi beach (S2a, S2b*) and the site 2 km away from Rajowdi beach (S3a, S3b*) (*a & b are for high tide & low tide respt.), which falls in between Rajodi and Arnala beach. Site S4 is Pond water from Achole road in NSP (E). This water isn't served for drinking or any other domestic purpose instead the pond is used for religious purposes i.e. Ganpati idol immersion and other holy purposes. Also the pond is cleaned from time to time.

Physicochemical and Microbial Analysis: The samples were analyzed for 24 parameters. The physical parameters like pH and temperature were determined on site using pH paper and thermometer (±0.1) respectively. The chemical & microbial parameters were analyzed by Standard Methods (APHA) [3]. The parameters and their technique of analysis are listed in table 2. All chemicals used were of A.R. grade and double distilled water was used throughout this study.

Fig. 1: Sampling locations



For reverse way study- The heavy metals detected were lead, copper, chromium, cadmium, iron, manganese, zinc, mercury and nickel, but chromium and cadmium were not detected throughout the study period. The average concentration of metals were calculated from the values obtained throughout work and their standard solutions were prepared. The average concentrations for remaining metals are as follows (Table 1):

Table 1 Average Concentration of Metal Solutions

Metals	Average concentration (ppm)
Cu	0.16
Pb	0.03
Ni	0.06
Zn	0.85
Mn	1.00
Fe	0.80

For various metal ion solutions physical parameters such as viscosity was determined using Ostwald's viscometer and surface tension was determined by Drop number method using stalagmometer, refractive index for the various combinations of metal ion solutions was determined with the help of Abbe's refractometer.

For determination of transport number small pouches of 10 cm^3 of metal solution was dipped and kept aside for 24, 48 and 72 hours. Gelatin paper was used for making pouches. After 24 hours the pH and conductance of the water was measured. Similarly pH and conductance was measured after 48 and 72 hours and noted. After this the solutions were mixed with each other for eg. Cu with Ni; Cu with Pb; Cu with Fe etc. and same procedure was used as for a single metal solution. The values obtained were subtracted from the blank (Double Distilled Water) and the final readings were recorded.

Results and Discussion

The results obtained are compared with World health organization (WHO), European Standards and Beaureau of Indian Standards (BIS-10500:1991) [4-6].Table 2 gives the methods used to determine physico-chemical parameters with its comparison with the standards.

pH is a measure of acidity or alkalinity and measures the concentration of H^+ ion in solution. There was no significant difference in the values of pH. For pH, range of 6-8.5 is recommended. The pond water sample was in this range. The values of conductance in study were seen to increase in all sea water samples but it decreased in pond water sample. Also the value was within limits as per standard. No significant difference in the values of temperature was observed. No significant difference in values of DO was observed. In study the values of turbidity were within the permissible limit in pond water sample. In case of sea water samples there was a high rise in the values of turbidity after visarjan.In this study, there was no significant difference in the values of hardness. The values of hardness in all water samples were in the permissible limit of 600 mg/L set by IS: 10500. There is no significant difference in values of Ca, Mg, Na and K in all water samples. The pond water sample falls within the permissible limits by IS: 10500 for Ca 200 ppm, Mg 100 ppm and in the range by WHO and EU for Na 200 ppm. The Cl^- content increased in pond water sample S-4 post visarjan sample but was found to be within the desirable limits set by IS: 10500. In sea water samples there was no significant difference.

In present study, the values of sulfate increased in all sea water samples after visarjan whereas in case of pond water sample there was no significant difference observed. The sulfate value for pond water sample was within the permissible limits by IS: 10500 (i.e. 400 mg/L). In pond water sample the value of nitrite laid in the range of 0.5 ppm as per EU standards before visarjan but after visarjan the value increased as high as 1.6 ppm. There was no significant difference in the values of F^-. The pond water sample had values within range by IS: 1500 of desirable limit 1 ppm.

The values of Cu were seen to increase after visarjan in all sea water samples and in pond water sample, in fact in case of pond water sample the value was more than the permissible limit by IS:10500 (1.5 ppm) reaching up to 2.45 ppm . The values of lead in all water samples increased after visarjan. The value in sample S-4 was very high after visarjan. Nickel in pond water increased after visarjan and it was as high as 0.24 ppm whereas there was no significant difference observed in sea water samples for Ni. Zn has increased in all water samples after visarjan but it was well within the desirable limits, in case of pond water, set by IS: 10500. There was no significant difference observed for Fe in all water samples. Also, for pond water sample the value was within the permissible limit by IS: 10500. There was no significant difference observed in the sea water samples but in case of pond water the value increased after visarjan and it was alarmingly high as compared to standard. Cr, Cd and Hg were below detection limits at all sampling stations.

Viscosity

It is seen that relative viscosity for copper is 1.071. The values for combined metal solution are increased for all other combinations except for Cu-Pb which is 1.040. The highest value is seen for Cu-Ni which came out to be 1.147. The value of relative viscosity for lead is 1.031. The value of all other combinations decreased, except that for Pb-Cu which came out to be 1.040. The lowest being for Pb-Ni 0.999. The value of relative viscosity for zinc is 1.00. All other values increased except Zn-Fe which is 0.995. The highest value is for Zn-Mn 1.054. The value of relative viscosity for Nickel is 1.08. All other values increased except for Ni-Pb which is 0.999. The highest value recorded is for Ni-Cu 1.147. The value of relative viscosity for manganese is 1.013. The values for all combinations increased highest being 1.108 of Mn-Cu. The value of relative viscosity for iron is 1.013. The value for all other combinations increased except for Fe-Zn which is 0.995.

Specific Refractivity

The specific refractivity of DDW is 0.20543. The value of Cu is 0.20498. The values increased for all the combinations except for Cu-Mn which came out to be 0.20483. The value for lead is 0.20523. The value for all other combinations increased except for Pb-Zn (0.20481) and Pb-Fe (0.20479). The value for zinc is 0.20571. The values for all other combinations decreased, the lowest being for Zn-Pb (0.20481). The value for Ni is 0.20389. The value increased for all other combinations highest being Ni-Cu (0.20532). The value for manganese is 0.20367. The value for all other combinations increased highest being Mn-Pb (0.20523). The value of specific refractivity for iron is 0.20395. The values or all other combination increased highest being Fe-Cu (0.20543).

Surface Tension

The value of surface tension for copper is 77.29531. The value for all combinations decreased, lowest being for Cu-Fe (66.682). The value of surface tension for Pb came out to be 78.9146. The value for all combinations decreased lowest being Pb-Ni (68.981) The value of surface tension for zinc is 77.063. The values for combination of metals decreased, the lowest value is for Zn-Ni (64.66). The value of surface tension for nickel is 82.7998. The values for all combination metals decreased, lowest value is for Ni-Zn (64.66). The value of surface tension for Manganese is 75.5224. The values for all combinations decreased and the lowest value recorded is for Mn-Pb (69.05). The value of Surface Tension for Iron is 72.341. The values for all combinations decreased except for Fe-Zn and Fe-Mn where the values increased and reached upto 74.165 and 74.314. The lowest value was for Fe-Cu (66.682).

Transport of Ions

The experiment was carried out by dividing the standard metal ion solutions with all its combinations in four sets. pH and Conductance was calculated.

2.1 Set 1 pH, Conductance.

When observed for 24, 48 and 72 hours, and compared with blank (DDW), the values increased after 24 and 48 hours but decreased after 72 hours. Similarly for corrected specific conductance the values increased after 24 and 48 hours but slightly decreased after 72 hours.

2.3 Set 2a pH and Corrected specific conductance

The values for pH when compared with blank increased for all three time sets i.e. after 24, 48 and 72 hours. The values when compared with blank increased after 24 and 48 hours but decreased after 72 hours.

2.5: Set 2b pH and Corrected specific conductance

The values of set 2ii for pH increased after 24, 48 and 72 hours. Similarly for corrected specific conductance the values when compared with blank increased after 24, 48 and 72 hours.

2.7: Set 2c pH and Corrected specific conductance

The values of set 2c for pH increased after 24, 48 and 72 hours. Similarly for Corrected Specific Conductance the values when compared with blank increased after 24, 48 and 72 hours.

Table 2

Sr. No.	Physico-chemical parameters	Method/Instrument used	WHO Standards (1993)	EU Standards (1998)	IS: 10500	
					Desirable limit	Permissible limit
1	Temperature	Thermometer	___	___	___	___
2	pH	pH paper	No guidelines	Not mentioned	6.5-8.5	No relaxation
3	Turbidity	Turbidimetry	No guidelines	Not mentioned	5	10
4	Electrical Conductivity	Conductometry	250	250	No guidelines	No guidelines
5	Total Hardness	Titrimetric	No guidelines	Not mentioned	300	600
6	Calcium	Titrimetric	___	___	75	200
7	Magnesium	Titrimetric	___	___	30	100
8	Sodium	Flame Photometer	200	200	___	___
9	Potassium	Flame Photometer	___	10	___	___
10	Chlorides	Titrimetric	250	250	250	1000
11	Nitrites	Spectrophotometric method	___	0.5	___	___
12	Sulfate	Turbidimetric method	250	250	200	400
13	Fluorides	Spectrophotometry	1.5	1.5	1	1.5
14	Cu	ICP-AES	2	2	0.05	1.5
15	Zn	ICP-AES	___	___	15	
16	Mn	ICP-AES	0.5	0.05	0.1	0.3
17	Fe	ICP-AES	No guidelines	0.2	0.3	1
18	Ni	ICP-AES	0.02	0.02	___	___
19	Pb	ICP-AES	0.01	0.01	0.05	No Relaxation
20	Cd	ICP-AES	0.003	0.005	0.01	No Relaxation
21	Hg	ICP-AES	0.001	0.001	0.001	No Relaxation
22	Cr	ICP-AES	___	___	0.05	No Relaxation
23	Dissolved Oxygen	Winkler Method	No guidelines	Not mentioned	___	___

Table 3: Physicochemical parameters before and after Ganpati immersion

Parameters	Avg. Before Immersion	Avg After Immersion	Std Deviation Before Immersion	Std. Deviation After Immersion
pH	6.714286	6.285714	0.48795	0.48795
temp °C	27.85714	29.78571	0.899735	1.409998
turbidiy (NTU)	3.141429	24.34286	2.276828	14.91809
elec.cond (mS/cm)	12.57095	35.00143	10.5568	15.29064
hardness (mg/L)	5307.1	4651.281	2155.274	1936.776
ca hardness	849.32	767.8286	277.8206	252.3297
Mg hardness	3826.616	3295.167	1625.558	1430.761
Ca as Ca^{+2} (ppm)	340.0643	296.0043	111.3104	95.75271
Mg as Mg^{+2} (ppm)	1078.45	949.9786	454.2417	412.4788
Na (ppm)	11597.37	8544.419	5083.502	3874.06
K (ppm)	380.5729	304.7857	161.6396	134.7757
Hg (ppm)	ND	ND	ND	ND
Cu (ppm)	0.063429	1.885429	0.019646	0.617684
Zn (ppm)	0.270857	1.221714	0.227372	0.697437
Mn (ppm)	0.509714	0.347143	0.181107	0.404224
Fe (ppm)	1.315571	0.490571	0.80348	0.392515
Cr (ppm)	ND	ND	ND	ND
Ni (ppm)	0.045714	0.1454	0.060813	0.091435
Pb (ppm)	0.044714	0.316571	0.032525	0.163027
Cd (ppm)	ND	ND	ND	ND
NO-2 (ppm)	2.557143	1.6	1.654143	0.321455
Cl-1 (ppm)	15297.32	13852.34	6741.464	6253.142
F-1 (ppm)	0.851429	0.94	0.190125	0.106615
Sulphate (ppm)	599.64	1901.181	133.5776	754.4092
D.O.	2.742857	4.675714	1.319616	1.958272

Table 4: Viscosity, Specific refractivity and Surface tension of metal solutions

Metals/Parameters	Relative Viscosity	Specific Viscosity	Specific Refractivity	Surface Tension
DDW	-	-	0.20543	-
Cu	1.071	0.071	0.20498	77.29531
Cu-Pb	1.040	0.040	0.20523	71.516
Cu-Zn	1.132	0.132	0.20511	70.06302
Cu-Ni	1.147	0.147	0.20532	66.88267
Cu-Mn	1.108	0.108	0.20483	70.06302
Cu-Fe	1.079	0.079	0.20543	66.682
Pb	1.031	0.031	0.20523	78.91464
Pb-Cu	1.040	0.040	0.20523	71.516
Pb-Zn	1.010	0.01	0.20481	71.66
Pb-Ni	0.999	-0.001	0.20521	68.981
Pb-Mn	1.014	0.014	0.20523	69.050
Pb-Fe	1.015	0.015	0.20479	71.588
Zn	1.00	0.00	0.20571	77.06296
Zn-Cu	1.132	0.132	0.20511	70.06302
Zn-Pb	1.010	0.01	0.20481	71.66
Zn-Ni	1.035	0.035	0.20490	64.660
Zn-Mn	1.054	0.054	0.20511	71.516
Zn-Fe	0.995	-0.005	0.20494	74.165
Ni	1.08	0.08	0.20389	82.79981
Ni-Cu	1.147	0.147	0.20532	66.88267
Ni-Pb	0.999	-0.001	0.20521	68.981
Ni-Zn	1.035	0.035	0.20490	64.660
Ni-Mn	1.040	0.040	0.20479	74.240
Ni-Fe	1.054	0.054	0.20491	71.588
Mn	1.013	0.013	0.20367	75.52244
Mn-Cu	1.108	0.108	0.20483	70.06302
Mn-Pb	1.014	0.014	0.20523	69.050
Mn-Zn	1.054	0.054	0.20511	71.516
Mn-Ni	1.040	0.040	0.20479	74.240
Mn-Fe	1.051	0.015	0.20470	74.314
Fe	1.013	0.013	0.20395	72.34099
Fe-Cu	1.079	0.079	0.20543	66.682
Fe-Pb	1.015	0.015	0.20479	71.588
Fe-Zn	0.995	-0.005	0.20494	74.165
Fe- Ni	1.054	0.054	0.20491	71.588
Fe- Mn	1.051	0.015	0.20470	74.314

Fig 2.25 Variation of pH with time

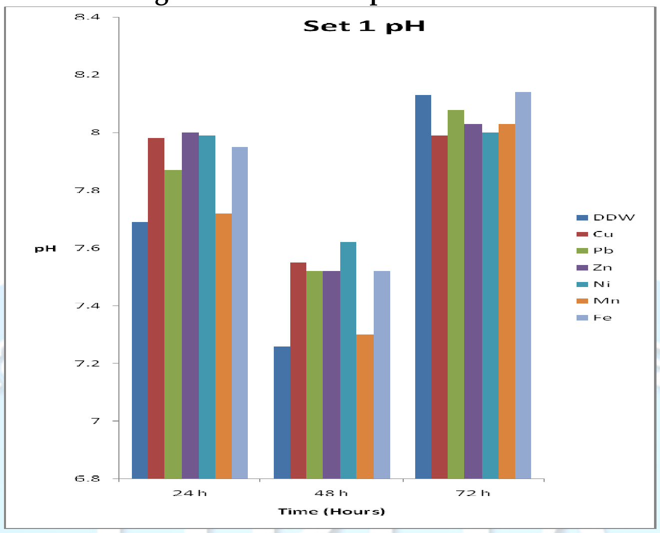


Fig 2.26 Variation of Corrected Specific Conductance with time

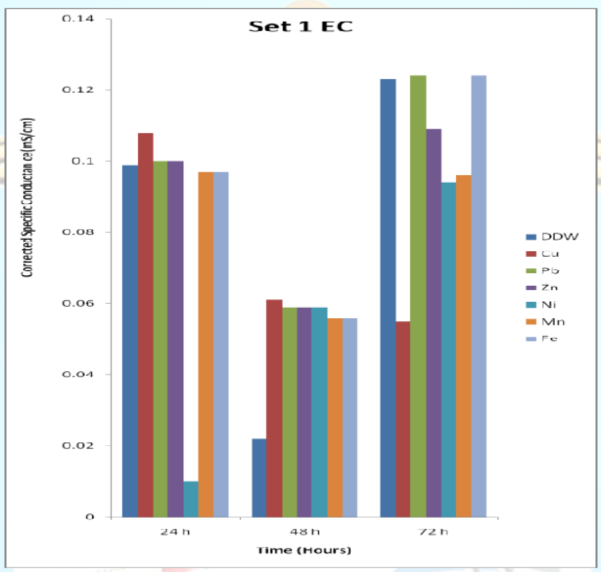


Fig 2.27 Variation of pH with time

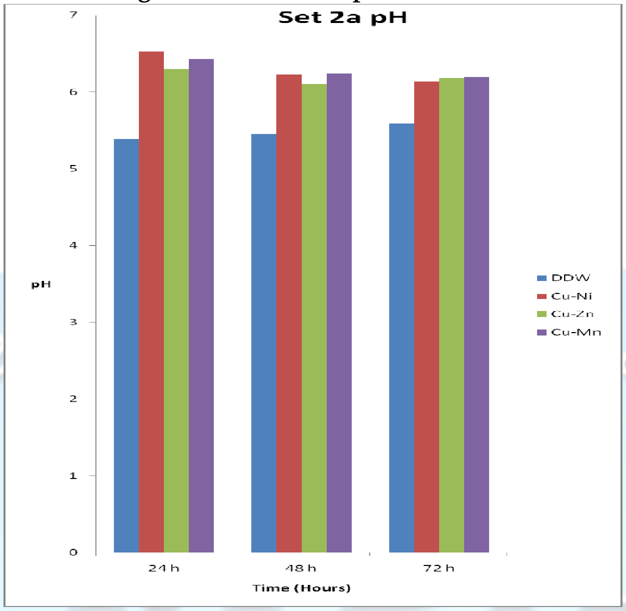


Fig 2.28 Variation of Corrected Specific Conductance with time

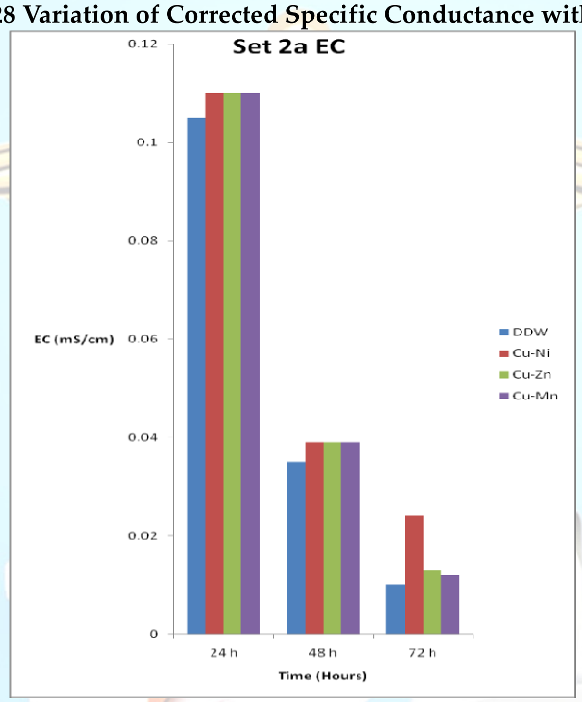


Fig 2.29 Variation of pH with time

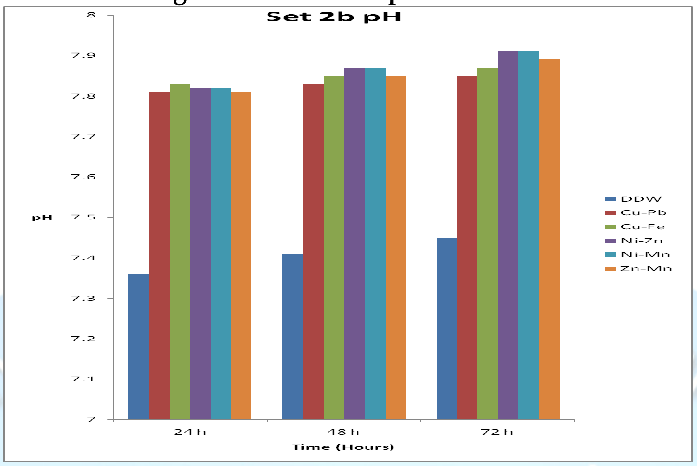


Fig 2.30 Variation of Corrected Specific Conductance with time

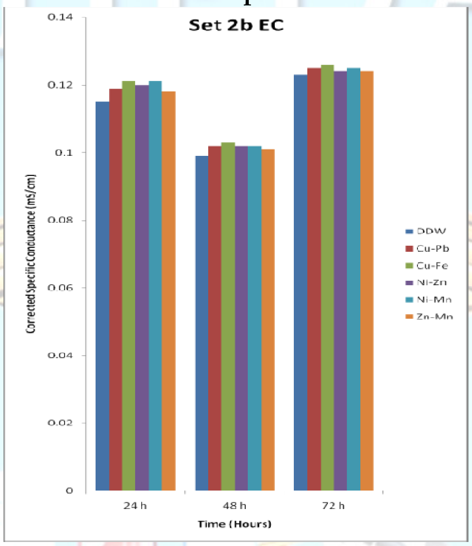


Fig 2.31 Variation of pH with time

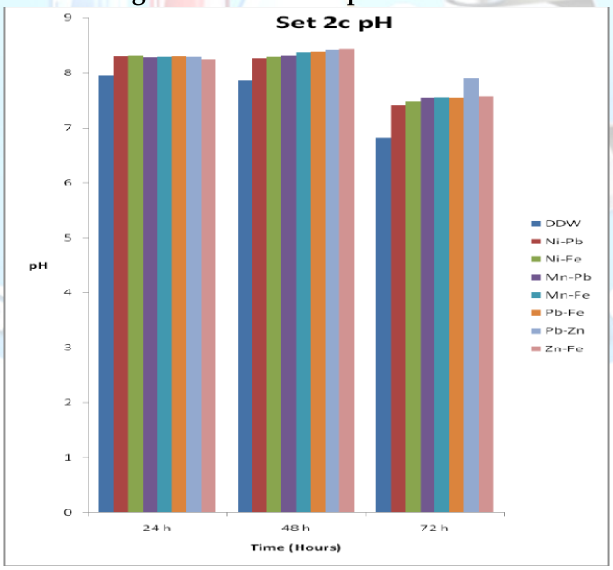
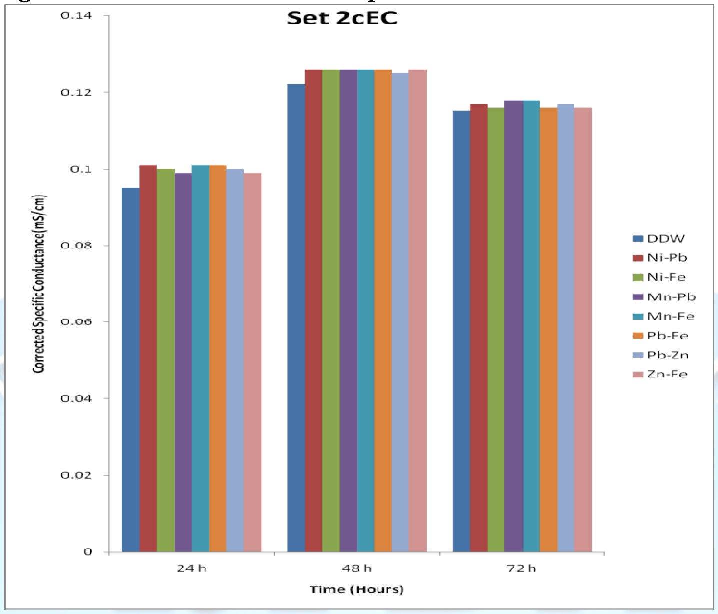


Fig 2.32 Variation of Corrected Specific Conductance with time



CONCLUSIONS

The quality of sea and pond water samples collected was analyzed and studied. The values for turbidity increased for all sea water samples. Also post visarjan the amount of nitrite in all pond water samples increased and were well above the limits. All the pond water samples seem to be polluted with high content of potassium. The metals like Ni and Zn increased in pond water after visarjan and were well above the limits. The pond water samples S-4 are highly polluted with the rise of lead content after visarjan.

In the reverse study in case of Cu the relative viscosity increased sharply on addition of Zn whereas specific viscosity increases for Ni. Comparative effects are seen in refractivity and viscosity in case of Ni. The reverse effect is seen on addition of Pb. The viscosity and refractivity slightly decreases.

In case of Pb the viscosity and refractivity was found to decrease on addition of various transition metal ion. For zinc the refractivity increases with addition of Pb whereas viscosity remains almost unchanged. For Ni-Cu sharp changes are observed for viscosity and refractivity. Mn-Ni, Mn-Fe and Mn-Cu the refractivity and viscosity is found to increase sharply. For iron, Fe-Zn concentration is observed to have negative effect on viscosity but positive effect on viscosity but the effect for refractivity. Significant increase is observed for Fe-Mn combination.

These studies indicate that there is considerable change in the quality of water in terms of physicochemical parameters. As shown by direct studies many of the heavy and transitional elements also affect the properties of water. It can be therefore suggested that Ganapati immersion leads to water pollution with as evidenced from the study of various physicochemical parameters.

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