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Limnology And Corrosiveness Of Different Water Samples Of College Of Military Engineering Pune (ms India) And Nearby Vicinity

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Abstract:Limnological investigation has been carried out on degraded water samples from CME (College of Military Engineering Pune, MS INDIA)) lakes, bore well , Mutha, Mulla and Pawana rivers. Waters from CME lakes and nearby vicinity are used for domestic as well as for military purposes. It is most significant to know water quality parameters and their effects on entity which exposed in practical use. Therefore it is essential to carry out study of water quality parameters, suitability for drinking purpose and stability (scaling-non scaling tendency) of water samples from CME and nearby vicinity. In the present study a comprehensive assessment of water quality parameters, suitability for drinking purpose and stability of water samples have been carried out by measuring pH, conductivity , fluoride, chloride ,TDS, alkalinity , hardness, , Langelier Saturation Index (LSI), Ryznar Index (RI) etc. and the corrosiveness on mild steel. It was found that most of the waters are within the WHO permissible limit. As for as the stability is concerned 75 % water samples have scale dissolving tendency and only 25% water samples have scale forming tendency. Further, most of the waters are corrosive in nature. As for as the corrosivity is concerned, the values of pH, Cond, Fluoride, chloride ion concentration, TDS, Total hardness, Alkalinity etc . 6.8, 1.11x103, 0.31, 89.2, 700, 201, 50 are aggressive for corrosion and 8.1, 1.30x103, 0.06, 140, 806, 406, 70 are non aggressive for corrosion towards MS.

Keywords: Geo-physico chemical parameters, LSI, RI, corrosion rate

INTRODUCTION:

While plenty of water is available in rivers, lakes, reservoirs, oceans only about 1% of fresh water is available for human use in the shape of surface and ground water. Water is used for irrigation, power production, industry, transport in addition to domestic use. Almost ¾ (72%)of the earth's surface is covered with water. Although water is the most naturally occurring common liquid , it is also one of the unusual. The total per capita demand of water is about 200L/head/day, which may vary from 100-300L/head/day1. Solid, liquid and gases effluent from various industries are generally exposed into the nearly environment. Almost all industry use water for some process or the other and finally discharge the waste water. Industries discharge Solid and liquid waste with or without adequate treatment which get deposited on the land or in waste bodies, thus soil and water resources become polluted. The domestic waste water consists of faecal matter and used water from bath, kitchen etc. This waste water contain 99% of water and 1% solids. It has been roughly assessed that the amount iron wasted due to corrosion is one-fourth of the world production. The direct loss due to corrosion in India amount to Rs. 200 crore/annum while money spent annually in controlling corrosion is the order of Rs. 50 crore. Estimates of the annual cost of corrosion in the United States vary between $8 billion and $126 billion2. The corrosion of iron and mild steel is a fundamental, academic and industrial concern that has received a considerable amount of attention3. The corrosion and inhibition efficiency of mild steel in acidic medium has been studied.4 The water samples were collected from the same sites in the month of January 2008 and were analysed5 and corrosion effect on mild steel by same water samples were studied.6 Corrosion and inhibition investigation has been carried out on mild steel in acidic medium7,8 and in well water9.

EXPERIMENTS

College of Military Engineering (CME) Pune (MS India) is a premier Technical Institute imparts engineering knowledge to the army personnel. Apart from engineering subjects CME also conducts other courses related to military. Waters from CME lakes and nearby vicinity are used for domestic as well as military purposes. Surface water samples from eight sites were collected in well sterilized 1000 ml capacity plastic bottles in the month of January 2013. pH and conductivity of water samples were measured by pH and conductivity meter. Total alkalinity was estimated by titrating the sample against standard sulfuric acid using phenolphthalein and methyl orange indicators. Total hardness was estimated by titrimetric method using EDTA, fluoride was measured spectrophotometrically using zirconium oxychloride (SPADNS photometric method),

TDS was measured by weight difference method using platinum crucible and vacuum dessicator, chloride was measured by using silver nitrate solution, Ca and Mg were measured using by EDTA, all the measurements were carried by standard methods .10

WEIGHT LOSS METHOD

The MS rod in the form of 70 mm diameter was obtained from supplier and cut into 30x20x5mm. The surfaces of specimen sample were smoothened and a hole was drilled near the upper edge. The specimens were cleaned by filing, polishing with emery cloth paper No 50, 60, 120 and buffing. Specimen degreased in alcohol, washed with water, dried and weighed to a constant weight before exposing to the corrosive medium. These specimens were suspended by a polymer in a beaker filled water samples. Specimens were kept immersed for a weak. After a weak of exposure, specimens were removed and cleaned as per 9,11 using concentrated HCl, 2% antimony trioxide and 2% stannous chloride, dried and weighed to calculate corrosion rate. Chemical composition of MS is given in table 1.

RESULT AND DISCUSSION

Water quality parameters are given in table 2.

pH: The pH values varies between 6.2 to 8, pH values more than seven indicates alkaline in nature that may due to photosynthesis activity. All pH values are within the WHO permissible limit.

Table 1.Chemical composition of MS

Materials	Weight %	Materials	Weight %
C	0.176	S	0.035
Mn	0.656	Nb	0.009
Si	0.177	Pb	0.001
P	0.029	Co	0.005
Cr	0.132	Ti	0.002
Ni	0.065	V	0.004
Mo	0.024	W	0.004
Cu	0.057	Fe	98.585

Conductivity: Electrical conductivity (EC) is directly related to the concentration of ionized substances in water. Higher EC in sample five(bore well water) is naturally due to the presence of more dissolved solids. All EC values are within the WHO permissible limit.

Fluoride: Fluoride ion concentration is in the range of 0.1 to 0.52. High concentration of fluoride in sample one may be caused by the contaminated domestic sewage. High concentration of fluoride in five may be caused by more dissolved solids. Fluoride ion concentration is in the range of 0.5-1.0 is essential for the prevention of dental carries. These values are within the WHO permissible limit.

Chloride: Chloride ion concentration is in the range of 60-140.Chlorides are not considered as harmful as such , their concentration over 250mg/L impart peculiar taste to the drinking water. Chloride ion concentration in sample five (bore well water) is higher it may be due to presence of more dissolved solids.

Table 2. Water quality parameters

Water sample	pH	Cond (S/cm) x10^3	F^- ion conc	Cl^- ion conc	TDS	Total Alkali-nity	Total Hard-ness	Ca	Mg
1	6.8	1.11	0.31	110	700	50	201	90	111
2	8.0	1.02	0.29	130	630	60	199	120	79
3	7.5	1.07	0.15	125	650	55	190	105	85
4	7.8	0.37	0.1	90	205	31.5	105	70	35
5	8.1	1.30	0.52	140	806	70	406	260	200
6	6.2	1.21	0.13	90.3	750	49	180	130	50
7	6.5	1.18	0.18	78.9	600	51	190	110	80
8	6.7	1.22	0.15	60	705	50	170	99	71

(Note- Sample 1(CTW lake), 2(Upper lake), 3(Middle lake), 4(Tap water), 5(Bore well water), 6(Mutha river, Holkar bridge), 7(Mula river, Harish bridge), 8(Pawana river, Dapodi). Concentration of all samples except pH and conductivity in ppm)

TDS: TDS leads adverse health problems, like gastrointestinal irritation, distress in cattle and livestock. All TDS values except sample four were recorded beyond the WHO permissible limit. High TDS values in sample 1-3 may be due to the droppings of various birds residing at the lake site. High TDS values in sample 6-8 may be due to the mixing of sewage and industrial effluents in to the rivers.

Alkalinity: Alkalinity as such not harmful to human beings. The alkalinity of all samples were recorded less than 100 ppm which are desirable for domestic use. These are all within the WHO permissible limit.

Hardness: Hardness below 300 ppm is considered potable but beyond this limit produce gastrointestinal irritation (ICMR, 1975). Hihger value of TDS in sample five is due to the presence of more dissolved solids present in bore well water. These all values are within the WHO permissible limit.

Calcium: It dissolves from rocks and soils which cause hardness and is deposited in conduit tubes and pipes. It has no adverse physiological manifestation on human system. A certain amount of calcium reduce heart trouble or cardiac disorder. All calcium values except sample five are within the WHO permissible limit.

Magnesium: It is an essential for humans, with an acceptable adult daily intake level of 350 mg. Lappenbusch reported that magnesium deficiency may result in electro lytic imbalance of calcium and potassium. At high concentrations in drinking water, magnesium salts may have laxative effects.

Magnesium is associated with hardness of water and is undesired in several industrial processes. All values except sample five are within the WHO permissible limit. Production and supply of non-corrosive and non-scaling water is essential for water quality control and to prolong the life of the water distribution system. Water can exhibit tendency to either dissolve or deposits certain minerals in pipe, plumbing and appliances surfaces. This tendency is known stability. Water that tends to dissolve minerals is considered corrosive and water that tends to deposit minerals is considered scaling. Corrosive water dissolves minerals, Ca, Mg, Cu, Pb etc. which disturb water quality. The water stability were determined by using Langelier Saturation Index (LSI).

The present study may be useful in corrosion control and prevention of $CaCO_3$ scaling in pipes, plumbing, water distribution system and particularly water used for cleaning and washing of military equipments.

LSI are calculated by the following formula[12]

LI = pH - pHs

pHs = (pK_2-pK_s) + pCa++ + pAlk –

Where LI is Langelier Saturation Index, pH the measured pH of water, pHs the pH at $CaCO_3$ saturation, pK_2 and pK_s are constant based on ionic strength and the total dissolved solids of the water, pCa^{++} the -log [Ca^{++}], pAlk - the -log[Alk -]

LSI values are given in table 3

If the LSI is zero, the water is in equilibrium and there is no net tendency of either scaling or corroding. A negative LSI , indicates that the sample under saturation and has tendency to dissolve CaCO and corrosion results, a positive LSI indicates that the over saturation of water and will tend to scale of $CaCO_3$.

As per analysed data from table 3, It was found that 62.5 % water samples have negative saturation value, indicating under saturation and have the ability to dissolve $CaCO_3$and have corrosive tendency, only 37.5% water samples have scale forming tendency.

Severity of the corrosivity and scaling tendency is clearly indicated by Ryznar Index (RI). RI can be calculated by using following formula.

RI = 2pH_s - pH

Where pHs and pH as indicated above. RI values are given in table3.

RI value range	Scale forming tendency
<5.5	Heavy scale formation
5.5-6.2	Some scale will form
6.2-6.8	Non scaling or non-corrosive
6.8-8.5	Corrosive
> 8.5	Very corrosive

Table 3. LSI

Water sample	pCa^{++}	$pAlk^{-}$	(pK_2-pK_s)	pH_s	LI	RI
1	2.65	3.0	2.48	8.13	-1.33	9.46
2	2.53	2.93	2.46	7.92	0.08	7.84
3	2.58	2.87	2.47	7.92	-0.42	8.34
4	2.76	2.20	2.23	7.19	0.61	6.58
5	2.18	2.86	2.50	7.54	0.56	6.18
6	2.49	3.0	2.49	7.98	-1.78	9.76
7	2.56	3.0	2.45	8.01	-1.51	9.52
8	2.60	3.0	2.48	8.08	-1.38	9.46

From table 3, it is seen that only one sample (5) having some scale forming tendency and one(4) having non scaling tendency. Samples 2 and 3 are corrosive and four samples (1,6,7,8) are very corrosive.

Corrosion study of water samples on MS has been carried out by weight loss method. The corrosion rates of MS in the water samples was calculated from decreased in weight observed in coupons in weigh test using following formula[2,13].

$$\text{Corrosion rate (mpy)} = \frac{534 \times w}{D \times A \times T}$$

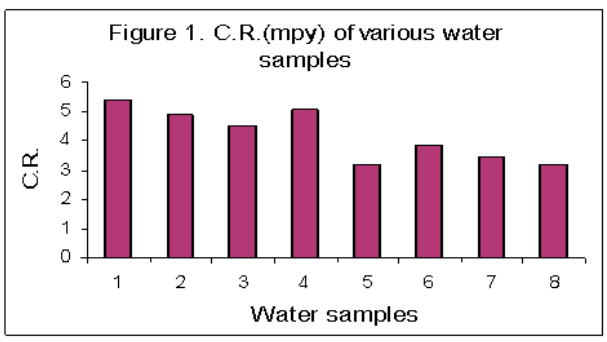
Where w is weight loss in mg, D the density of metal (8.23 g/cm3), A the exposed area of specimen (inch2), T the time of exposure in hours(168 hrs).

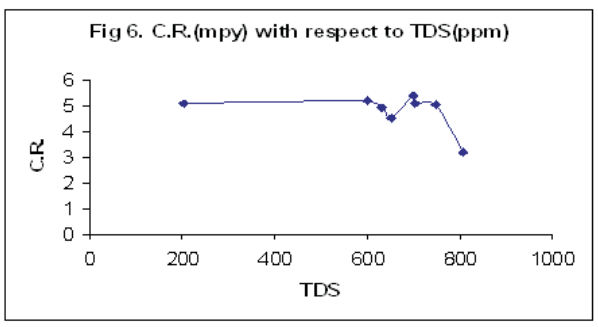
Corrosion rates of specimens are tabulated in table 4.

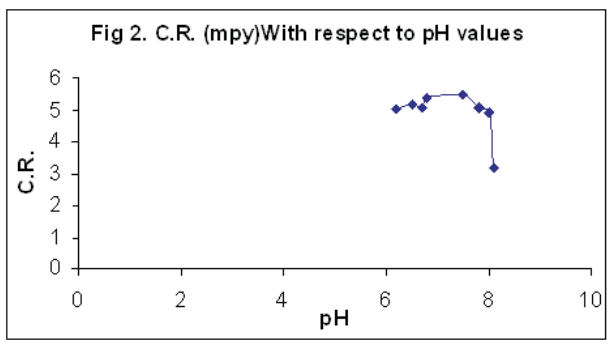
From table 4 it has been observed that corrosion rate of water sample 1 is more than all samples it may be due to presence of higher fluoride ion concentration, layer tends to spell from specimen surface can cause diffusion of oxygen concentration. C.R of water sample 4 is also higher because it has almost all the parameters low. C.R of water sample 5 is less it may be due to higher concentration of almost all the parameters, a protective could have been formed. C.R. of samples 6,7 & 8 is also higher because it may be due to samples are acidic in nature. C.R.of all water samples and their relation with pH, Conductivity,fluoride ion concentration, chloride ion concentration, TDS, total hardness, alkalinity etc. are shown graphically in figure 1,2,3,4,5,6,7 and 8.

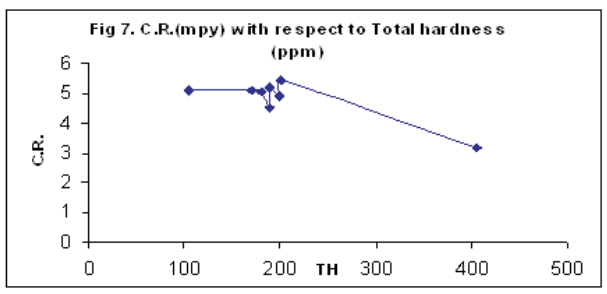
Table 4. Corrosion rates of MS

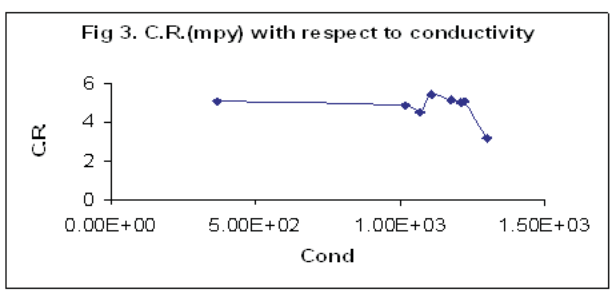
Water sample	Weight loss (mg)	Area ($Inch^2$)	Corrosion rate (mpy)
1	31.2	2.23	5.41
2	32.9	2.59	4.90
3	29.2	2.51	4.50
4	33.2	2.52	5.09
5	20.8	2.53	3.18
6	33.1	2.54	5.03
7	34.2	2.55	5.17
8	33.2	2.51	5.10

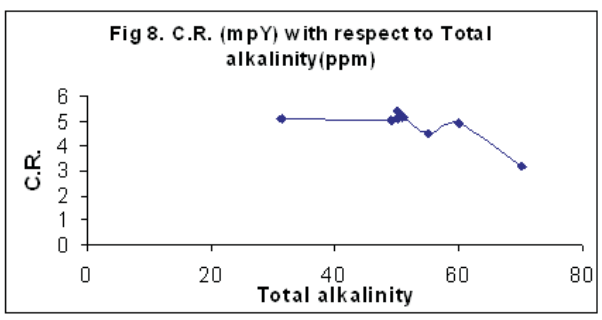


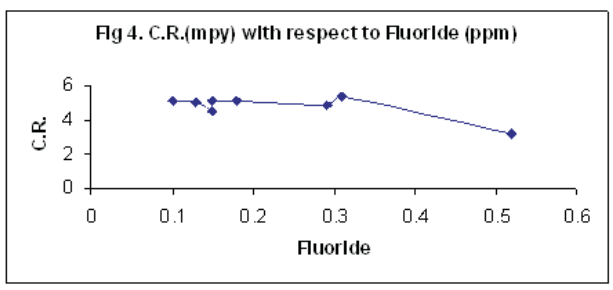


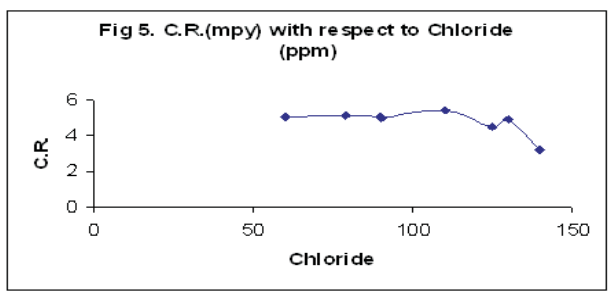












CONCLUSION

From the present study of water samples, it can be concluded that the water samples of CME and near by vicinity are within the WHO permissible limit.

The chemical study of the water samples revealed that water quality parameters are within the WHO permissible limit but the samples except 4 and 5 can be rejected on aesthetic ground. As for as the stability is concerned 62.5 % water samples have negative saturation value, indicating under saturation and have the ability to dissolve $CaCO_3$and have corrosive tendency, only 37.5% water samples have scale forming tendency.

The values of pH, Cond, Fluoride ion conc, chloride ion conc, TDS, Total hardness, Alkalinity etc . 6.8, 1.11x103, 0.31, 110, 700, 201, 50 are aggressive for corrosion and 8.1, 1.30x103, 0.52, 140, 806, 406, 70 are non aggressive for corrosion towards MS.

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