SEASONAL MONITORING AND STATISTICAL ANALYSIS OF GROUND AND SURFACE WATER QUALITY IN THE SANGANER AREA OF JAIPUR, RAJASTHAN

Dr. Ruchi Jain, Dr. Neerja Upadhyaya, Dr. Ranjan Upadhyaya, Renu Bala Sarma
1Assistant Professor, 2Assistant Professor, 3Professor, 4Assistant Professor
1,2Department of Chemistry,
1,2,4S.S. Jain Subodh Girls P.G. College, Sanganer, Jaipur, India 302029.
3Taxila Business School, Jaipur, Rajasthan, India.

Abstract: The degrading environment, polluted and limited resources of useable water, bad quality of water, scarcity of water supply are such global issues which are a matter of worry all over the world. Thus, along with surface water, ground water has also become a significant water resource. Both surface water and ground water interact with each other. These interactions are affected by numerous natural phenomena and anthropogenic activities all around the water bodies.

Few essential and heavy metal contents in Ground water and Surface Water samples from selected sites of Sanganer area, Jaipur, Rajasthan, India were analyzed by Atomic Absorption Spectrophotometer. Ground water and Surface water qualities were compared with the International standard values. The data obtained was subjected to statistical analyses. Sources of metal salts were identified.

Both the Ground water and Surface water were found to be contaminated with a comparable rate. Amongst all the metals, nutrient metals were found to be in the permissible limit while few of the heavy metals were above the WHO limits in few samples. Studies reveal that the resolution of the problem requires awareness and control of contaminants in industrial, domestic and agricultural effluents.

IndexTerms – anthropogenic activities, ground water, surface water, WHO limit.

I. INTRODUCTION

A report issued by United Nations World Water Development in 2003 stated that although liquid water is present on 70% of the Earth, only 2.5% of this water is fresh and even less than 0.3% of this water is useable for us. Human population is on such a steep rise that a report presented in November 2009 revealed that by 2030 the demand to supply ratio of water will increase by almost 50% resulting in water crisis all over.

Insipde of various laws and policies, available water is being continuously contaminated due to anthropogenic activities as the population has raised steeply[1]. Water pollution is affecting not only human health but also altering aquatic flora and fauna by changing aquatic environment and climate [2]. Various studies are being carried out in this regard [3-6]. Rajasthan is included in the top five salinity affected states in India and comparatively very high percentage of habitations is affected by water quality in Rajasthan. This has promoted numerous studies in the state [7-11]. Present work is based on the water analysis in the industrial area of Sanganer, Jaipur, Rajasthan, India. Study area is about 25 km away from the heart of the city and various textile, printing industries [7] are located in this area which has affected the quality of Surface water and Ground water. Agricultural and anthropogenic activities have increased the amount of the pollutants in the water resources which is causing changes in the physiochemical parameters continuously. This has encouraged study of various parameters of water quality in this area. Here Calcium, Potassium, Zinc, Cadmium, Mercury, Lead content in Ground water and Surface water are being discussed with their statistical analysis.

Calcium and magnesium are essential to human health but cause hardness in water. Studies suggest health effects of hard water cause worse effects on health including cardiovascular disease, cancer, cerebrovascular mortality, alzheimers disease, diabetes etc. [12]

Potassium is also an nutrient metal ion which is introduced to the water sources through water softener using potassium chloride can add significantly to the intake of potassium when compared with the amount that would be generally consumed with drinking-water, even when the water treated had water hardness levels usually permissible.[13]

Mercury, lead and cadmium are considered as toxic metals and are known to cause various adverse health effects on excess intake. Anthropogenic activities introduce mercury, lead and zinc to environment and these heavy metals cause oxidative renal damage to different extents [14]. Cadmium is known to cause renal disorders resulting cancer. These effects are found to be pronounced when cadmium consumed with lead [15].

Studies of kidney dysfunction and osteoporosis indicate that adverse effects may occur at lower exposures than was previously thought.

Although these data show that a proportion of the general population may be at increased possibility for tubular dysfunction when exposed to cadmium at the PTWI, the risk estimates that can be made with current information are imprecise.[16] JECFA [17,18] considered all of the new data but decided that, in view of the uncertainties, the existing PTWI of 7 μg/kg of body weight should be retained.
II. EXPERIMENTAL

Water samples were collected from the different sites of the selected area in triplicate from January 2018 to December 2018. The Determination of all the selected elements viz. Calcium, Potassium, Zinc, Lead, Mercury and Cadmium was carried out with the help of Atomic Absorption Spectrophotometer (Schumadzu AAS-4129) at different wavelengths. Water samples were completely digested in 10:1 HNO₃ and perchloric acid mixture. These mixtures were heated on hot plate until clear solutions were obtained and then slow heating was continued to completely evaporate the acids. Volume of the digested mixture was made up to 100 ml with double distilled water. These solutions were analyzed spectrophotometrically. Results were compared with international permissible limits and further analyzed statistically.

III. RESULTS AND DISCUSSION

The template Results obtained for various parameters are summarized graphically (Fig. 1 to 6) and statistical data is given in Table 1. The permissible value of Calcium is 10 mg/l to 200 mg/l. Figure 1 indicates that the calcium concentration varied from 171 mg/l to 176 mg/l in surface water and from 92 mg/l to 95 mg/l in ground water samples. Calcium content in the water influences toxicity of other elements like lead, copper, zinc which are less toxic in hard water due to presence of calcium but highly toxic in soft water. Toxic effects of calcium depend upon its counter ion. For example- calcium carbide on contact with water forms ethyne which is toxic. Excess consumption of calcium is harmful for humans.

**Fig 1. Average Monthly Calcium Concentration in surface water and ground water**

Figure 2 depicts the concentrations of potassium in water samples of surface and ground water. 10 mg/l is the acceptable level of potassium in drinking water. Surface water was found to have high potassium level as compared to ground water samples. The major source of potassium concentration in the water sources of study area is erosion and run off from the agricultural fields, the water of which contains synthetic fertilizers.

**Figure 2 Average monthly Potassium concentrations in surface water and ground water**

Potassium and its compounds are also used in fertilizers, glass factories, production of liquid soaps, medicines, photography, matchsticks, fireworks, paper glue, synthetic rubber and other domestic waste etc. High potassium in surface water leads to increase in Potassium concentration in ground water too, due to infiltration process. Its toxicity is generally due to the anion in its compounds. For example- toxicity of KCN is due to CN⁻.

The analysis results for Zinc in surface water and ground water are depicted in Figure 3, which shows that Zinc concentrations in surface water samples were found to be very high and above the permissible limit. This is due to high usage of Zinc fertilizers by the farmers which comes with runoff in the rainy season and is added in surface water of Dravyavati river. In ground water samples, it was found towards higher side of permissible limit i.e. 5 mg/l to 7 mg/l.

Physiologically zinc it is involved in sexual development, replication of DNA, boosting immune systems, enzymatic processes, protects from poisoning due to cadmium and also helps in low absorption of lead, etc.
Figure 3. Average monthly Zinc concentrations in surface water and ground water

Analysis of Lead in surface and ground water has been shown in Figure 4. Maximum acceptable limit for Lead in drinking water is 0.01 mg/l. Lead concentrations in ground water was found to be within permissible limit and in some samples there was no sign of lead, whereas, in surface water samples, concentrations of lead was found to be on higher side, which is hazardous for living beings as well as for the survival of aquatic life.

Figure 4. Average monthly Lead concentrations in surface water and ground water

Various sources of lead contamination are use of leaded paint, gasoline fuel, lead acid batteries, stained glass, jewellery, toys etc. The major source of Lead in surface water is direct dumping of battery waste (e-waste) in the sewage line.

Lead may also be present in drinking water distributed through pipes containing lead or pipes connected with lead solder. According to drinking water standards (IS:10500), the maximum permissible limit for Mercury is 0.001 mg/l. Figure 5 reveal the Mercury concentrations in surface and ground water samples were within permissible limit. The major sources of mercury are human activities like industrial processes, burning of coal for heating and cooking, waste incinerators, mining etc.. Dumping of wastes straight away from home based chemical industries and small scale industries within the area are the leading cause of Mercury concentrations.
The maximum permissible limit for Cadmium is 0.003 mg/l. Figure 6 reveals the status of Cadmium concentrations in surface and ground water samples. Surface water had greater amount of cadmium than ground water, though, in both, concentrations of cadmium were found within permissible limits.

Paramount industrial releases of cadmium are due to waste stream and leaching of landfills and from a variety of operations involving cadmium or zinc. Deterioration of galvanized plumbing, along with industrial waste contamination or surface waste contamination by certain fertilizers are recognized as the main sources of cadmium contamination in drinking water supplies.
There is a requirement to control the amount of lead and zinc in the water sourced in the Sanganer area of Jaipur, Rajasthan. Surface water was found to be contaminated and groundwater concentrations of all the parameters except mercury, lead, cadmium, the results are significant at p < 0.05.

### Table 1

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Combined Standard Deviation</th>
<th>t-value</th>
<th>Significance of result at (p = 0.05)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Potassium</td>
<td>0.14</td>
<td>36.36</td>
<td>Significant at p &lt; 0.05</td>
</tr>
<tr>
<td>Calcium</td>
<td>1.34</td>
<td>147.53</td>
<td>Significant at p &lt; 0.05</td>
</tr>
<tr>
<td>Zinc</td>
<td>0.71</td>
<td>32.19</td>
<td>Significant at p &lt; 0.05</td>
</tr>
<tr>
<td>Lead</td>
<td>≈ 0</td>
<td>Not significant</td>
<td>not significant at p &lt; 0.05</td>
</tr>
<tr>
<td>Mercury</td>
<td>≈ 0</td>
<td>Not significant</td>
<td>not significant at p &lt; 0.05</td>
</tr>
<tr>
<td>Cadmium</td>
<td>≈ 0</td>
<td>Not significant</td>
<td>not significant at p &lt; 0.05</td>
</tr>
</tbody>
</table>

The t-test conducted to find out if there was any difference between the samples of surface water and groundwater reveals that in case of all the parameters except Mercury, Lead, Cadmium, the results are significant at p < 0.05.

### IV. Conclusion

Concentration of cadmium and mercury was found to be below permissible limit both in surface and groundwater. In case of lead, only surface water was found to be contaminated and ground water concentration of lead was under permissible limit. There is requirement to control the amount of lead and zinc in the water sourced in the Sanganer area of Jaipur, Rajasthan.

### References