ISSN [Online]: 2583-2654

Some Case Studies on Environmental Protection
(Editorial Article)

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Abstract: Ground water is better in quality than surface water. In most of the rural areas, the population depends mainly on ground water for their needs. The provision for clean water for all continues to be the goal of many governments and international organizations for decades. The urban runoff is highly polluted with pathogenic and organic substances that can have serious consequences for the receiving water bodies (surface and ground) and ultimately to the people who depend on them. The objective of the present study to investigate the extent and impact of pollution on environment due to different sources of pollution. Different practical case studies are discussed to find how the object of study is achieved.

Keywords: Ground water, clean water, sources of pollution, impact on environment

1. INTRODUCTION

Ground water is better in quality than surface water. In most of the rural areas, the population depends mainly on ground water for their needs. The provision for drinking water in sufficient quantity and good quality has posed a great challenge to water resources engineers. The provision for clean water for all continues to be the goal of many governments and international organizations for decades. Unfortunately, that goal is still out of reach especially for the developing countries. Attempts are afoot to achieve the said goal. The necessity of large proportions of the urban population to rely upon itself for the supply of basic water supply and sanitation facilities has and continues to cause related problems viz., overexploitation of ground water sources, and disposal of untreated wastes in open areas and pollution of ground waters. Most urban centers in the developing world lack facilities that are adequate for proper collection and disposal of domestic and industrial wastes. The urban runoff is highly polluted with pathogenic and organic substances that can have serious consequences for the receiving water bodies (surface and ground) and ultimately to the people who depend on them. 80% of tropical diseases are said to be water related and can be attributed to poor or non existing sewage treatment system and lack of safe drinking water. In many areas sewerage systems are simply non - existent, with wastes being disposed into surface drainages. The press of our growing population and the increasing affluence of our society have resulted in more and more people buying home sites in the relatively isolated areas. Developing of home sites is accelerating around city suburbs and in rural pockets. These home sites often require individual wells and sewage disposal systems. Because many sewerage systems are improperly designed, wells and streams in the area are susceptible to contamination.

2. OBJECTIVE

The objectives of the present study are as follows

1. To study the extent of ground water contamination due to different sources of pollution on ground water quality.
2. To study the impact of pollution on environment due to different sources of pollution.

3. CASE STUDIES

Case Study 1

The newly developing slums around already developed urban centers lack protected water supply and sewerage system. The dwellers of slum areas depend on piped water supply from bore wells and open dug wells and resort to septic tank / on-site sanitation system for disposal of domestic waste. However, the majority of

ISSN [Online]: 2583-2654

these are incorrectly designed and their working performance is far from satisfactory. Visakhapatnam is the second largest city in Andhra Pradesh state, a sprawling industrial city and is one of the emerging metropolis. Visakhapatnam is located on East Coast of India about 870 kilometers south of Kolkatta and 760 kilometers north of Chennai (17º43' N Latitude and 83º17' Longitude) covering an area of 150 square kilometers. In Visakhapatnam most of slums are located on road and railway margins, lower hill slopes, sides of large city drains (gedda), beach side, old core of the city and other marginal lands. Physiographically, the Visakhapatnam appears as a small basin surrounded by Yarada Hill range on the south, Kailasa Hill range on north; Narava hill range on the west and Bay of Bengal on the east.The field investigation has been limited to Arilova colony slum in Visakhapatnam based on its hydrogeological features, terrain and population.

Following investigations have been carried out to study the extent of ground water contamination

1. Physico-chemical analysis of ground water samples exposed to leachates of on-site sanitation systems to study the impact of on-site sanitation on ground water quality.

2. Water quality indices for ground water samples of study areas to assess its potability and to summarize large amounts of water quality data into simple terms.

Surveys were conducted physically for selection of sampling sites. Information regarding the available and existing on-site sanitation systems was collected by home-to-home survey. Based on information procured twenty wells from individual houses identified in the study area, which are having well and on-site sanitation units nearby and within the home.

Based on the investigations carried out the following conclusions are drawn.

1. The study of two years duration revealed that water quality of the domestic wells is fast deteriorating with high levels of nitrate and chloride in the study area.

2. Seasonal monitoring data reveals fluctuations in organic and inorganic contaminant levels in response to rainfall events.

3. The average NO_3 concentration of majority wells showed more than the maximum permissible levels as per ICMR during the study period. Higher population density and higher density of on-site sanitation units and waste disposal in the surrounding areas might have resulted in elevated concentrations of nitrates in the ground water adjacent to these areas.

4. It is thought that the chloride peaks may result in part from washing through evaporative soil deposits formed during the dry season in addition to loading from effluents of low cost sanitation system.

5. In the present study high concentrations of chlorides, EC and nitrate levels in five wells out of 20 indicating a close relationship between chloride and nitrate suggesting a single dominant source. The findings of the present study agree with the results of Barrett et al., (1999)[15].

6. Correlations between different parameters studied were statistically analysed. A significant correlation was observed between EC, B.O.D, Cl, K and TH in the study area. pH has shown negative correlation with B.O.D.

7. Based on WQI the quality of water is good in 20 to 30% of wells in winter and summer and whereas in rainy season 55% of wells shown good in water quality in the study area. The remaining wells shown the water quality poor to very poor in all the sampling wells in all three seasons. Based on WQI the quality of water is good in 20 to 30% of wells in winter and summer and whereas in rainy season 55% of wells shown good in water quality. The remaining wells shown the water quality poor to very poor in all the sampling wells in all three seasons.

8. Based on the findings of the investigation, it is observed that present rule of thumb requiring safety distance depends upon the prevailing on-site soil conditions; it is necessary to take into account the ground water level. A safety limit of 1 m but preferably 3 m should exist between the bottom of leach pit and

ISSN [Online]: 2583-2654

ground water table. The limit must account for seasonal fluctuations in ground water table. The major finding from this study is that it is very difficult to prevent ground water contamination particularly in an unconfined aquifer in human settlements, which employ low cost sanitation units at every housing unit. In this regard they become so numerous for the variable hydro geological environment. It is too expensive both in terms of finance and technological effort to ascertain the hydro geological environment at the individual house level, such that it is possible to accurately advise each householder where they should locate their on-site sanitation unit. This realization leads to a fundamental concept that the best approach in minimizing ground water contamination in peri urban human settlements is through the provision of community on – site waste disposal systems which could be well managed; otherwise the ground water and health of the people will be highly vulnerable. It is also likely that if deep-rooted vegetation such as shrubs and trees could be introduced into the areas, the situation could be improved.Measures to minimize / eliminate such contamination should be adopted in areas of high beneficial use so that ground water aquifers and the nutrient status of the soil are protected. Further studies should be continued on the movement and fate of pollutants released from on-site sanitation system in the subsurface environment.

Case Study 2

As there is a scarcity of potable water in many places, impure water is being used sometimes for mixing as well as curing of concrete in the civil engineering constructions. An experimental investigation was carried out to find out the most affecting acid in curing. Batch experiments were conducted to study the influence of 1% H_2SO_4, 1% HNO_3& 1% HCl in acid curing. It was found that compressive strength loss of concrete was maximum for H_2SO_4 curing and minimum for HCl curing. The sand was replaced by 20%, 40% and 60% copper slag in batch experiments to study the influence of copper slag on the strength of concrete in acidic environment.

Following batch experiments were conducted to study effect of the acidic polluted water on strength of concrete. Initially 12 cubes were casted using OPC (Ordinary Portland Cement) and 3 cubes were immersed separately in each container of Water (H_2O), Hydrochloric acid (HCl), Nitric acid (HNO_3) and Sulphuric acid (H_2SO_4).Then another 12 cubes were casted using PPC(Portland Pozzolonic Cement) and same curing procedure followed. Eventually the sand is replaced by 20%, 40% and 60% of CS (Copper Slag) and 18 cubes were casted, cured in water and sulphuric acid solution. The cubes are cured at 1% acid solutions and tested at 14, 21 and 28 days respectively.

The following conclusions are made based on the laboratory experiments carried out in the present investigation.

1. Copper slag concrete resisted acid attack in a better way as compared to conventional concrete at all stages of exposure to HCl, HNO_3, H_2SO_4.
2. It is observed that the percentage loss of compressive strength of copper slag concrete is considerably lower than that of conventional concrete mixes at all ages of acid exposure.
3. It is also observed that maximum loss of compressive strength and weight occurs in case of H_2SO_4 acid immersion as compared to HCl and HNO_3
4. The loss of compressive strength of conventional concrete is almost double the loss of compressive strength of copper slag concrete in H_2SO_4 acid immersion at all ages.
5. The weight loss of Copper Slag concrete is very low when compared to Conventional concrete mixes which were exposed to 1% acid solution.

Case Study 3

Chromium can exist in different oxidation states like Cr^{3+}, Cr^{5+} and Cr^{6+}.In the water environment, chromium exists primarily in the form of chromates(Cr^{3+}) . During the transformation of chromium in water environment, oxidation of Cr^{3+} and reduction of Cr^{6+} takes place depending upon environmental parameters. Furthermore, there is no evidence to indicate that the trivalent (Cr^{3+}) form is detrimental to human health. But, hexavalent

ISSN [Online]: 2583-2654

Chromium (Cr^{6+}) is a powerful oxidant, which can easily penetrate the biological membranes and irritate cells. High concentrations of Chromium are toxic to plants, animals and as well as humans. Most of the toxic effects of Chromium to man are associated with its occupational exposure rather than its intake with diet and water.

The potential sources of chromium in aquatic environment are effluents from

a. Tanning Industry
b. Textile Industry
c. Dyeing Industry
d. Paints and Pigment Industry
e. Electro Plating Industry
f. Petroleum Refinery
g. Fertilizer Manufacturing Industry
h. Mining and Metallurgical process

Effluent from electroplating industry was collected and analyzed for pH value, acidity, suspended solids, dissolved solids and Chromium. Batch experiments were conducted using this diluted sample to facilitate the comparison of the results with control sample.

Hibiscus Mutabulis (commonly known as hibiscus plant) leaves were collected locally and these leaves were dried, powdered and sieved using standard sieve (I.S. no. 0.075mm). The first stage of batch experiments were carried out using this sieved leaf powder. The second stages of experiments were carried out using Commercial activated charcoal (Merck make).

Batch experiments were conducted using diluted samples (each 104ml) of electroplating industry waste, taken in 250 ml beakers. All together the analysis was carried out in two stages. In the first stage analysis was carried out using leaf powder of Hibiscus Mutabulis. The first stage includes three phases of analysis for varying contact periods viz.30 minutes, 60 minutes, 90 minutes. In second stage, analysis was carried out using commercial activated charcoal. The second stage also includes three phases for varying contact periods viz. 30 minutes, 60 minutes, and 90 minutes.

The removal efficiency of Chromium by Leaf Powder of Hisbiscus Mutabulis and Commercial Activated Charcoal for different dosages and conducted in different phases by changing the amount of Leaf powder of Hisbiscus Mutabulis & Commercial Activated Charcoal and contact period. It was observed that contact period as well as dosage has considerable effect on the removal efficiency.

4. CONCLUSION

From the above result, it was observed that the percentage removal efficiency increased with increase in dosage of leaf powder of hibiscus mutabulis for a contact period of 60 minutes and 90 minutes. In the case of commercial activated charcoal the percentage removal efficiency increased with increase in dosage for a contact period of 30 minutes and 60 minutes. The percentage removal for activated charcoal increases with increasing contact periods and shows a similar trend for different dosages. The percentage removal for leaf powder of Hibiscus Mutabulis increases with increasing contact periods and shows no particular trend for different dosages.

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