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A Study on Effect of Treated effluent Irrigation on Agricultural and Geotechnical Properties of Soil

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Abstract: *The project work was carried out to investigate the effect of treated effluent irrigation on soil properties near the sewage treatment plant. The quality of treated waste water was studied to evaluate the performance of treatment units and the suitability of treated waste water for irrigation. The analyzed results of soil showed that pH, Electric conductivity, BOD, Available Nitrogen, Phosphorous and Potassium were affected due to the usage of treated effluent for irrigation. But there is no noticeable effect on geotechnical properties of the soil. The long-term usage of treated effluent for agricultural purpose caused soil sickness, accumulation of organic matter and various nutrients in the soil and thereby crop yield decreases.*

Key Words: Treated effluent, Sewage treatment plant, Soil, Irrigation

1.INTRODUCTION

Water is a basic need to lead a healthy and standard life. Nowadays, water scarcity has become major problem in all over the world especially in dry regions. The practice of low-quality water resources is advised as a solution for agricultural irrigation, which involves the largest global consumption of water. Environmental conservation and water pollution control is important to maintain living conditions for the succeeding years. Many researchers had stated that using treated wastewater effluent for farming as an alternative water resource due to rising scarcity of fresh water [1]. The amount of liquid and solid waste is increasing enormously with time and in parallel with raising industrial production and living standards. Disposal of industrial and domestic wastes into the environment will affect the both ground water and soil quality. Streams and soil have been utilized for various purposes, including waste disposal. Our incautious waste dumping has affected these inevitable resources. Structure of soil is very important factor for soil function in supporting plant growth, animal life and to maintain quality environment. Irrigation with treated municipal wastewater will change the properties of soil which depends on the various parameters present in the applied wastewater. The improper management of wastewater may have adverse impacts on soil and crops in which it affects the human health and environment [2]. Some studies states that the main parameters of the applied wastewater will impact on soil pH, NPK concentration and other properties of soil.

2. MATERIALS AND METHODOLOGY

2.1 Materials

To carry out the experimentations required for the project, various glass wares, reagents and some instruments are used in the laboratory.

2.2 Methodology

Step 1 – Selection of site. The site was selected near the Municipal Sewage Treatment Plant, Shivanagar, Davanagere where treated effluent is used for irrigation.

Step 2 – Collection of Sample. The disposed treated effluent was collected by using polythene water bottles and soil was collected by using core cutter method. Three samples of treated effluent and soil were collected at three different distances from the Sewage Treatment plant by considering site near to sewage treatment plant as site 1, intermediate site as site 2 and far site as site 3.

Step 3 – Conduction of experiments. Various parameters of soil and treated effluent were analyzed by using standard methods of experimentation in the specified laboratory. For Treated effluent parameters such as pH, turbidity, Color, Total dissolved solids, Electric conductivity, BOD and COD were analyzed. For Soil pH, Electric conductivity, NPK concentration, Specific gravity, Dry unit weight, Porosity, Void ratio, Swell Index and Permeability were analyzed.

Step 4 – Analysis of results and conclusion.

3. RESULTS AND DISCUSSION

The results obtained from the project work are discussed in this chapter by including various sections and sub sections along with the graphs.

3.1 Analyzed Characteristics of Disposed Treated Effluent

The parameters of three collected disposed treated effluent samples were analyzed and obtained results are tabulated in the below Table 3.1. Some parameters i.e., EC, Color, Turbidity and BOD are varied by following proper trend that is in declining in the values as the effluent flows and other

parameters were varies constantly without following any pattern.

Table 3.1 Analyzed Characteristics of Disposed Treated Effluent

Parameters	Site 1	Site 2	Site 3
pH	7.5	7.6	7.5
EC	1.13dS/m	1.02dS/m	1.0dS/m
Color	730PtCo	621PtCo	609PtCo
TDS	850ppm	770ppm	750ppm
Turbidity	91.6 NTU	55.3 NTU	51.9 NTU
BOD	64.27 mg/l	63.84 mg/l	63.21 mg/l
COD	147.82 mg/l	142.27 mg/l	145.34 mg/l

3.2 Analyzed Characteristics of Soil Sample

The soil samples were collected and analyzed for both geotechnical properties and some agricultural related parameters in the respective laboratories. The obtained results are as shown in the below mention Table 3.2

Table 3.2 Analyzed Characteristics of Soil Sample

Character	Site 1	Site 2	Site 2
pH	8.53	7.95	7.8
EC	0.5 dS/m	0.53 dS/m	0.65 dS/m
Nitrogen	294 kg/acre	266 kg/acre	278 kg/acre
Phosphorous	6.8kg/acre	13.6 kg/acre	9.4 kg/acre
Potassium	115.1 kg/acre	102.76 kg/acre	101.8 kg/acre
Specific gravity	2.31	2.55	2.65
Dry unit mass	0.097 g/cc	0.089 g/cc	0.105 g/cc
Swell Index	30%	20%	30%
Permeability	0.43mm/sec	0.68mm/sec	0.59mm/sec
Void ratio	1.41	1.86	1.52
Porosity	0.58	0.650	0.603

The pH of the soil sample at site 1 is 8.53, at intermediate site is 7.95 and at site 2 is 7.8 which is shown in the following Fig 3.1. The soil is more alkaline at all the three sites which reduces the supply of water to the roots and lowers its efficiency to absorb nutrients.

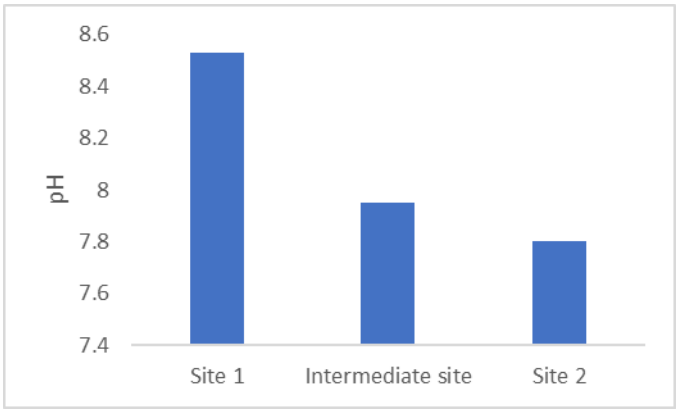

Fig 3.1 Soil pH

The EC of soil at site 1, intermediate site and at site 2 are 0.5dS/m, 0.53dS/m and 0.6dS/m respectively as shown in the Fig 3.2. EC at all the three sites is below prescribed range for agriculture which affects the soil texture and lowers the crop yield.

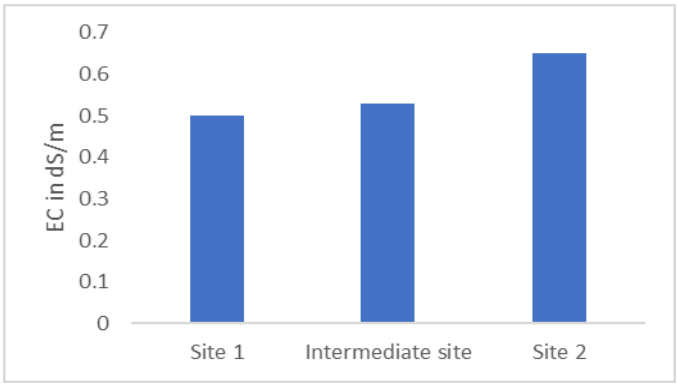

Fig 3.2 Soil EC

The Total Nitrogen of the collected samples are very high which is due to usage of treated effluent is as shown in the below Fig 3.3. The high level of total nitrogen in the soil will causes the plant burning and it affects the ground water by leaching the excess nitrates. Monitoring of proper nitrogen helps to attain the optimal plant growth.

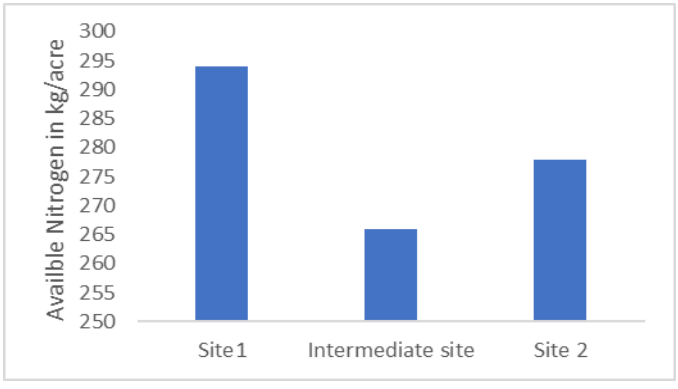

Fig. 3.3 Available Nitrogen in Soil

The Total available phosphorous in the soil is 6.8kg/acre, 13.6kg/acre and 23.2kg/acre at site 1, intermediate site and at site 2 respectively as shown in below Fig 3.4. Intermediate site has high phosphorous level whereas site 1 and site 2 have medium level. The phosphorous in the soil helps to production of energy which is required for photosynthesis, helps in root growth and overall growth of plants.

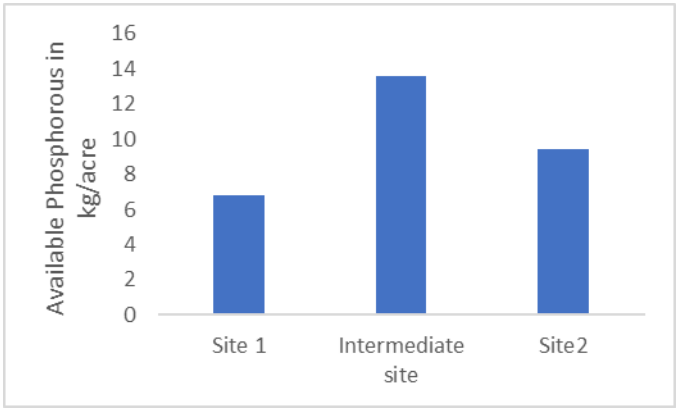

Fig 3.4 Available Phosphorous in Soil

The Available Potassium in the soil at the three sites is moderately high which is shown in the Fig 3.5. The potassium level at site 1 is 115.1 kg/acre, at intermediate site is 102.76 and at site 2 is 101.8kg/acre. A slightly higher potassium in soil does not causes any major problems to plant but too much level may lessen the inhibition of other minerals and nutrients which are responsible for plant growth.

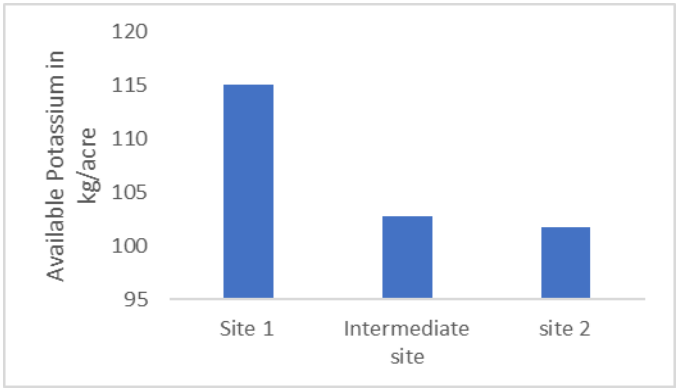

Fig 3.5 Available Potassium in Soil

The specific gravity of the soil at site 1, intermediate site and site 2 are 2.31, 2.55 and 2.65 respectively as shown in the Fig 3.6. The results shows that the soil contains organic matter and soil is not ideal for the construction purpose as it has low strength.

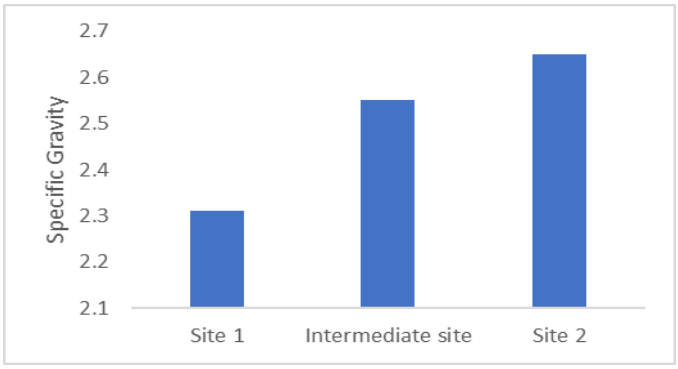

Fig 3.6 Specific gravity of Soil

Swell index of the soil at site 1 is 30%, at intermediate site is 20% and at site 2 is 30% as shown in the Fig 3.7. All the three soil samples have medium degree of expansiveness of swell index.

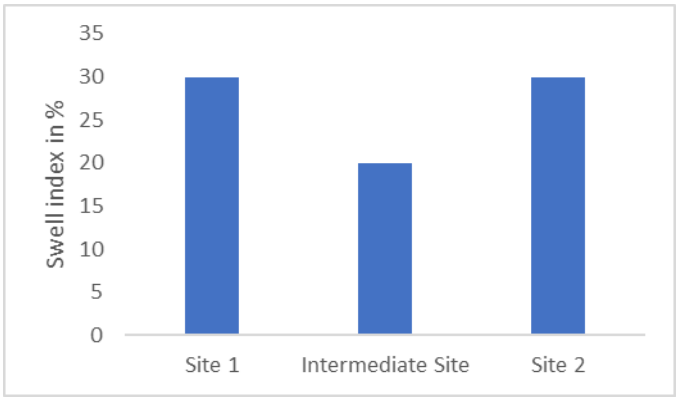

Fig 3.7 Swell index of Soil

Permeability of soil will help to transfer the fluids. Permeability at site 1 is 0.43mm/sec, at intermediate site is 0.68mm/sec and at site 2 is 0.59mm/sec as shown in the Fig 3.8. The results shows that it has lower permeability which means the soil has accumulation of impurities and organic matter due to the usage of treated effluent for irrigation.

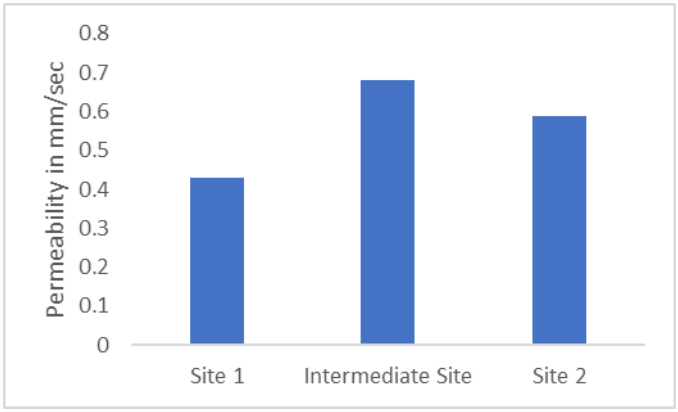

Fig 3.8 Permeability of Soil

The void ratio of the soil at site 1, intermediate site and at site 2 is 1.41, 1.86 and 1.52 respectively as in the Fig 3.9. The soil is fine grained which indicates that volume of soil does not increases under loading conditions.

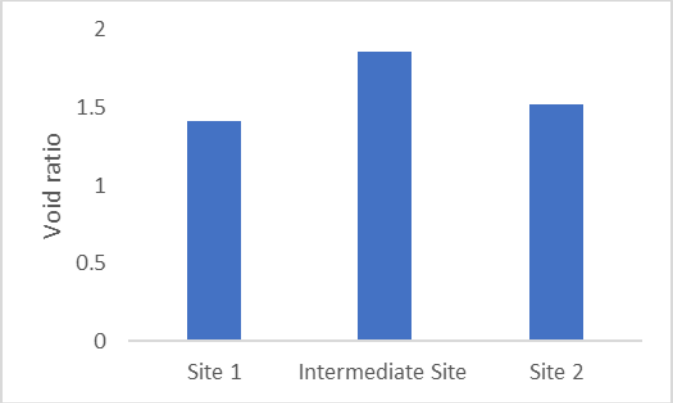

Fig 3.9 Void ratio of Soil

Porosity and void ratio are directly proportional to each other. The obtained results of porosity at site 1, intermediate site and at site 2 are 0.58, 0.65, 0.60 respectively as shown in the Fig 3.10. The porosity values indicates that the soil consists of organic matter.

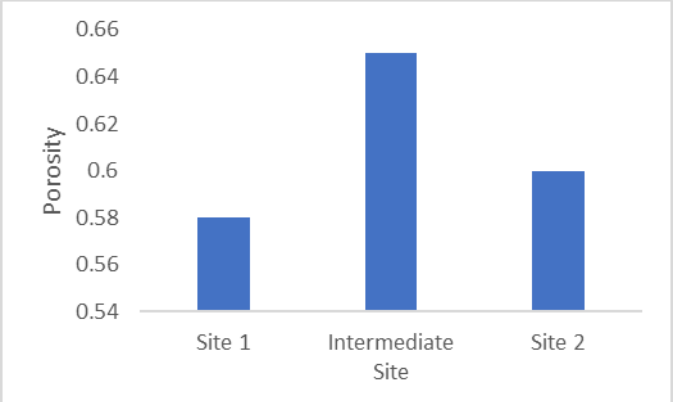

Fig 3.10 Porosity of Soil

5. CONCLUSION

The most of the disposed treated effluent parameters value decreased as it flows continuously through channel and some of the parameters were not followed any trend. Most of the treated effluent parameters were within the permissible limit for usage of agricultural purpose. The continuous usage of treated effluent for irrigation purpose in selected site caused increase in soil pH, Nitrogen, Phosphorous and Potassium concentration which results in soil sickness, accumulation of organic matter in the soil and hence soil voids are clogged and thereby crop yield decreases significantly. The permeability is too low in the soil to transfer the nutrients. The inhibition of growth of plants may occur due to increase in soil EC.

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