The Effect of Distance Between Well And Septic Tank on Ground Water Pollution

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Abstract- *Groundwater pollution (also called groundwater contamination) occurs when pollutants are released to the ground and make their way down into groundwater. The major pollutants include pathogens, nitrate, volatile organic compounds, etc. The study includes measuring the distance between well and septic tank at three different areas and determining the rate of pollution depending on the distance. This is a serious problem in case of people having less area of inhabitation their needs a safe distance between well and septic tank.*

The aim of this study is to determine the distance between well and septic tank, depth of well water and permeability of soil samples for determine the pollution. Different tests are being conducted including chloride, MPN and permeability. From the results obtained one can analyze when the pollution is occuring. After that providing a solution to some extent as awareness to the people.

I. INTRODUCTION

GENERAL

Clean water is one of the most precious resources on earth. Clean water is life's most important basic necessity. Water is the most abundant compound on earth's surface, covering 70 percent of the planet. In nature, water exists in liquid, solid and gaseous states. Water is a chemical compound with chemical formula H2O.A water molecule contains one oxygen and two hydrogen atoms connected by covalent bonds. Water is a liquid at standard temperature and pressure, but it often co-exists on earth with its solid state near hydrophilic surfaces.

Water covers 71% of earth's surface, and is vital for all known forms of life. On earth 96.5% of the planet's water is found in oceans, 1.7% in groundwater, glaciers and ice caps of Antarctica and Greenland. A small fraction in other large water bodies, and 0.001% in the air as vapour, clouds and precipitation. Only 2.5% of the earth's water is fresh water, and 98.8% of that water is in ice and groundwater. Less than 0.3% of all freshwater is in rivers, lakes and the atmosphere, and even smaller amount of earths freshwater is in biological bodies and manufactured products.

Water on earth moves continuously through the hydrological cycle of evaporation and transpiration, condensation, precipitation, and runoff. Evaporation and transpiration contribute to the precipitation over land. Safe drinking water is essential to humans and other life forms even though it provides no calories or organic nutrients.

Usage of water is not limited to the human consumption on the country; it is used in the development of a great diversity of productive activities such as agriculture, cattle rising, tourism, health and diverse industrial activities. The demand of drinking water in the world continues to increase, since 1900 the demand has grown six fold. An important aspect to taken into account is population growth, about 12,000 million inhabitants by the middle of the 21st century. In order to provide better living condition for mankind, constant technological developments in several productive fields around the world are expanding, which in turn generate large amounts of new waste with final destination commonly to water bodies.

II. MATERIALS AND METHODS

This chapter discusses the tests and analysis employed in the study. The presence of chloride and coli-form in water is determined from chloride and MPN test. The permeability of soil is estimated from permeability test.

III. TESTS CONDUCTED

CHLORIDE TEST

The sample is brought to a PH of 7-10 by adding H2SO4 or NaOH as required. Then 100ml of sample was taken in an Erlenmeyer flask and 1ml of potassium chromate indicator is added to the sample. It is then titrated against a standard silver nitrate titrate till the pinkish yellow colour is attained the volume of titrate is noted (V1).The same procedure is repeated for blank and volume of titrate is noted (V2)

Calculation

Chloride in mg/l = (V1-V2xNx35.45) x1000)/V

Where
V-Volume of sample in ml
V1-ml of titrant for sample
V2 -ml of titrant for blank
N-Normality of silver nitrate solution

MPN TEST

A1 broth medium may be prepared from the commercially available dehydrated form.10ml of A1 broth medium is filled in 10 test tubes. Before sterilization, the fermentation tubes with inverted vials are dispersed in the test tube.

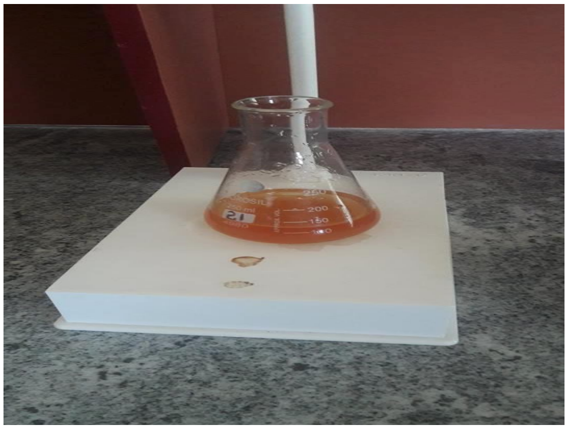

Figure 1. Sample titrated

The test tubes are covered with metal or heat resistant plastic caps. Sterilized in autoclave for 10 minutes. It is cooled in room temperature and 10 ml of sample is added to the test tube and mixed thoroughly. The sample is incubated at 35 degree Celsius for 3hours and 44.5 degree Celsius for 21 hours. After incubation the gas formation and rising of fermentation tubes indicates the presence of faecal coli- form.

Figure 2. Samples for testing

Figure 3. Test tube showing positive result of MPN

Figure 4. Soil samples for testing

GRAIN SIZE ANALYSIS

Suitable quantity of oven-dried dry soil had taken and weighted it. The soil had sieved through the standard set of sieves by the sieve shaker, starting from sieve No.4.75 mm to sieve No.75 micron in the decreasing order of sieves.

PERMEABILITY

CONSTANT HEAD TEST

The cylindrical mould had filled to the required level with the soil, keeping the porous stone /disc at the bottom. The other porous stone had placed at the top. The rubber ring had kept on the top of the mould and position the collar. The inflow of the top plate had connected to overhead tank. The inflow had opened and allowed the water to flow. When all the air had expelled, overflow is closed. Sufficient time had allowed for the water to flow and saturate the soil sample. The discharge for a given time had measured, when a constant flow had been established.

Calculation

k= (QL)/A
Where,

Q=Quantity
L=Length of sample
A=Cross sectional area of the sample
t=Time h=Head

FALLING HEAD METHOD

The specimen had prepared same as constant head method. The parameter with the soil had connected to the falling head stand pipe. The air flow valve had opened and water is allowed to flow. The air valve is closed when all air had expelled. The head above the tail water had measured at a particular instant when a steady state of flow is reached and after a known interval of time the dropped head had measured. The observations had repeated after adding water to stand pipe.

Calculation

k= (2.303 aL)/At x log h1/h2
Where,
a=Area of the stand pipe
L=Length of sample
A=Cross sectional area of the sample
t=Time h1=Initial head
h2=Final head

Figure 5. Permeability Test

IV. RESULTS AND DISCUSSIONS

CHLORIDE TEST

Calculations

Chloride in mg/l = (V1-V2xNx35.45x1000)/V
Where,
V= volume of sample in ml
V1= ml of titrant for sample
V2 = ml of titrant for blank
N= Normality of silver nitrate solution

Maximum limit of chloride content is 250mg/l. Water samples having chloride content above 250mg/l are unfit for drinking. For locally available sources the chloride content is approximately 3.5mg/l. But the above results are more than 3.5mg/l.

MPN test

Observations

Table 1. Table MPN test

Sample No.	Distance between well and	No. of test tubes giving positive	MPN Index/100ml
1	15	1	1.1
2	18	1	1.1
3	32	0	<1.1
4	4	1	1.1
5	6	2	2.2
6	7	2	2.2
7	9	1	1.1
8	14	3	3.6
9	6	2	2.2
10	10	2	2.2

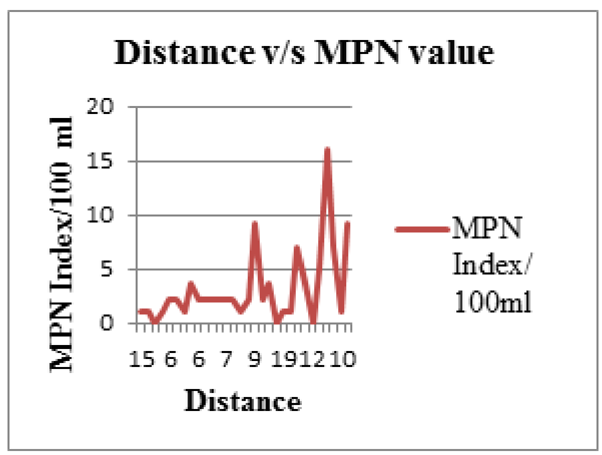

Figure 6. Relation of MPN value and distance between well and septic tank

GRAIN SIZE ANALYSIS

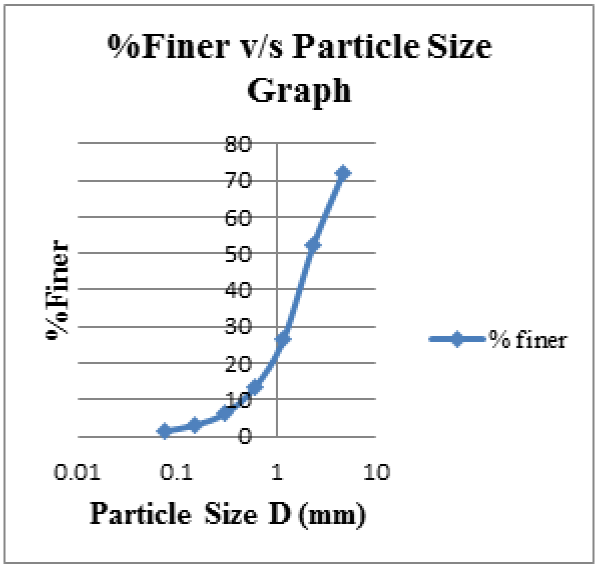

Figure 7.

Finer v/s Particle Size for samples from Muvattupuzha and Ayyanthanam colony Grain Size Analysis for sample from Kodanchery and Pathipara Colony.

Observations

Table 2.

IS Sieve No.	Particle Size D(mm)	Weight of soil retained(g)	% weight retained	Cumulative % retained	%finer (100-cum. %)
4.75	4.75	34.5	34.5	6.9	93.1
2.36	2.36	38.3	7.7	14.6	35.44
1.18	1.18	105	21	35.6	64.44
600	0.6	303	60.6	96.2	3.84
300	0.3	11	2.2	98.4	1.64
150	0.15	25	1	99.4	0.64
75	0.075	1.26	0.24	99.7	0.32

Observations

Grain Size Analysis for sample from Error

Table 3.

IS Sieve No.	Particle Size D (mm)	Weight of soil retained	% weight retained	Cumulative % retained	%finer(100-cum.retained)
4.75	4.75	139.1	27.82	27.82	72.18
2.36	2.36	10.2	20.04	47.86	
1.18	1.18	128.5	25.7	73.56	52.14
600	0.6	66	13.20	86.76	13.24
300	0.3	35.2	7.04	93.8	6.2

Calculations

- Effective size D10=0.72

Uniformity coefficient Cu=D60/D10=1.1/0.89=1.53

Co-efficient of curvature Cc= (D30)2/D10xD60= (0.89)2/0.72x1.1=1

Calculations

- Effective size D10=0.46

Uniformity coefficient Cu=D60/D10=2.9/0.46=6.3

Co-efficient of curvature Cc= (D30)2/D10xD60= (1.4)2/2.9x0.46=1.5

From the above results, among the collected soil samples first one is sand and the other is clayey sand.

PERMEABILITY TEST

CONSTANT HEAD TEST

Observations

Table 4. Constant Head Test

Head cm Head h (cm)	Time(t) (s)	Quantity Q(cm^3)	Coefficient of permeability, k(cm/s)	Avg.k(cm/s)
78	180	6	0.0000707	
78	180	6.5	0.000076	0.00024
78	180	8	0.000094	

Calculations

k= (QL)/A
Where,
A= Cross sectional area of pipe
L=Length of sample

FALLING HEAD TEST

Observations

Table 5. Falling Head Test

Initial Head h_1(cm)	Final Head h_2(cm)	Time t(s)	Coefficient of permeability, k(cm/s)	Avg.k(cm/s)
142	122	90	2.17×10^{-4}	
142	122	85	2.3×10^{-4}	2.3×10^{-4}
142	122	80	2.5×10^{-4}	

Calculations

k= (2.303aL)/At x log (h1/h2)
Where,
a=Area of stand pipe
L=Length of sample
A= Cross sectional area of pipe

From the results, both the soil belongs to poor drainage category. Both of them are fine and coarse sands.

V. CONCLUSION

From our study conducted, we can conclude that for samples from the area of Error near Adivaram i.e., sample from 1 to 11 the least distance among them is 4m.For this sample the MPN index is 1.1 and at the same time for the greatest distance of 18m, MPN index is also 1.1.But for distance of 14, 10 and 11m is it is 3.6 and 2.2 so, we can infer that as distance increased pollution decreases.

Then coming to the area of Pathipara colony near Nellipoil, for the least distance of 4m ,MPN index is 1.1 and for 10m, it is 2.2 so, we can infer that as the distance increased, pollution slightly increased .This is due to the permeability of soil in that area.

Then for the area of Housing board colony, Kodanchery, for the least distance of 9m, MPN index is high .So there is coliform bacteria and therefore shows pollution.

Among the three areas, the third area is the highly polluted area satisfying our reviews about the topic. Alternative solutions include placing a separate tank for pouring chlorine, placing of gravel and coal in front of outlet of septic tanks or attaching filters in front of outlet pipes of the septic tank. It is very useful for people having area less and no other ways of maintaining the safe distance of 10 m.

The study focuses only on the effect of distance between well and septic tank on groundwater pollution. There are also other reasons for the pollution to occur. One can test the soil samples and find the components causing the pollution in soil through which the water percolates. Also can make a study on the diseases caused by the pollution by this way. There may be many other solutions to these problems in the near future.

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