Experimental Analysis of recharging ground water and stagnant water management through infiltration

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Abstract

Background: Stagnation of water is one of the problems where the stagnant water is evaporated or it is not used for any purpose. Recharging of ground water will help the stagnant water to be utilized for increasing the ground water table. To encourage the penetration of water in the arena and to reduce the worse impact in the environment and eco-friendly material reduces the impact of present and future stagnation problem.

Tests and Admixtures: Various tests were done to find out the penetration of water and the time taken for infiltration by addition of admixture. Different admixtures were collected based on their properties that are organic and non chemical in nature.

Result: The test conducted with addition of admixture gives better result in means of infiltration of water in soil and so it helps in recharge of ground water by increasing the water table level.

Keywords: Vermicompost, Stagnant water, Infiltration, Ground water recharge.

1. Introduction:

The increasing demand for water in the country has brought forward the realization that the underground reservoirs formed by the aquifers constitute invaluable water supply sources as well as natural water storage facilities. The planned augmentation of water storage in the ground water reservoirs by suitable recharge techniques is useful for reducing over-draft, conserving surface runoff and increasing available ground water supplies. Recharge may be incidental, when it is a byproduct of normal land and water utilisation measures and planned when the work is carried out with the sole objective of augmenting ground water storage to improve water availability or water quality, reduce impact of floods or preventing/stopping sea water intrusion.

Ground water recharge techniques have been developed world over through large number of experimental projects implemented with diverse objectives. Whereas the aim of majority of the projects was to augment ground water storage by utilizing surplus rainy season flows or the waste waters; projects for beneficiation of water quality, conserving surface waters for subsequent use and stopping land subsidence were quite common. In India, the applicability of technologies to tropical conditions has been evaluated through a number of studies conducted by Central Ground Water Board and the State Ground Water Organisations.

2. Why Artificial Recharge:

Average annual water resources in our river basins are estimated as 1,869 billion cubic metres (BCM) of which utilizable resources are of the order of 1,086 BCM. Out of this, 690 BCM is available as surface water and the remaining 396 BCM as ground water. The source of all this water is rain or snow. The huge ground water storage of 396 BCM is the result of rain and snowmelt water percolating through various layers of soil and rocks. However, the amount of percolation varies greatly from region to region and within the same region from place to place depending upon the amount and pattern of rainfall (i.e. number and duration of rainy days, rainfall amount and intensity), characteristics of soils and rocks (i.e. porosity, cracks and loose joints in rocks etc.), the nature of terrain (i.e. hills, plateaus, plains, valleys etc.), and other climatic factors like temperature and humidity. As a result, availability of water from sub-surface storages varies considerably from place to place.

According to UNEP artificial recharge of groundwater is the planned human activity of augmenting the amount of groundwater available through the works designed to increase the natural replenishment or percolation of surface waters into the groundwater aquifers, resulting in a corresponding increase in the amount of groundwater available for abstraction (UNEP, 2000). Central Groundwater Board of India defines artificial recharge as the process by which the groundwater reservoir is augmented at a rate exceeding that under natural conditions of replenishment (CGWB, 1994).

3. Tests and Admixtures:

There are two types of test- Lab test and Field test.

Soil permeability test is conducted as lab test. The soil permeability is a very important factor to study the behavior of soil in its natural condition with respect to water flow. Falling head permeability method is adopted. Natural and an artificial set up were employed to conduct field test. Amount of water infiltrated at a given time period is studied.

Admixture collection and analysis:

Various admixtures were collected based on their organic nature in order to increase the infiltration of stagnant water into the soil.

Admixtures used- Dry sugarcane ash, Corn husks ash, Vermicompost, DAP, Complex, Urea and Cow dung.

4. Results:

i. Lab test:

The lab test is carried out by filling the sieved soil into the mould and time taken for penetration of water, the amount of infiltrated water is calculated and also by adding the collected admixture. Time taken and the amount of infiltrated water is compared with other results

Soil: First, the test is carried out by analyzing the amount of water infiltrated (Fig 1) and time taken for infiltration of water without adding any admixture. Total time taken for infiltration of water into the soil is 13 min 23 sec.

S.NO	INITIAL HEAD h1 (cm)	FINAL HEAD h2 (cm)	TIME INTERVAL t (sec)	INFILTRATED WATER (ml)
1.	100	80	89.29	80
2.	80	60	103.74	67
3.	60	40	138.23	72
4.	40	20	188.42	68
5.	20	0	286.50	70
AVERAGE =				71.4

Fig 1. Sieved soil test

Sugarcane and Corn husk Ash: The amount of water infiltrated by adding the prepared ash with soil is shown in Fig 2. Total time taken for infiltration of water into the soil is 13 min 23 sec.

S.NO	INITIAL HEAD h1 (cm)	FINAL HEAD h2 (cm)	TIME INTERVAL t (sec)	INFILTRATED WATER (ml)
1.	100	80	104.7	77
2.	80	60	136.54	69
3.	60	40	141.26	61
4.	40	20	211.76	70
5.	20	0	238.64	62
AVERAGE =				67.8

Fig 2. Sieved soil test with Ash

Vermicompost: Normal Soil test with adding 25% and 50% of vermicompost is tested and the obtained results are shown in Fig 3, Fig 4 and Fig 5. Times of infiltration are 6 min 29 sec and 4 min 2 sec respectively.

S.NO	INITIAL HEAD h1 (cm)	FINAL HEAD h2 (cm)	TIME INTERVAL t (sec)	INFILTRATED WATER (ml)
1.	100	80	28.54	70
2.	80	60	60.99	70
3.	60	40	99.41	70
4.	40	20	145.77	68
5.	20	0	201.27	70
AVERAGE =				69.6

Fig 3. Normal soil test

S.NO	INITIAL HEAD h1 (cm)	FINAL HEAD h2 (cm)	TIME INTERVAL t (sec)	INFILTRATED WATER (ml)
1.	100	80	45.52	72
2.	80	60	103.66	72
3.	60	40	174.44	75
4.	40	20	266.16	70
5.	20	0	389.34	70
AVERAGE =				71.8

Fig 4. 25% of Vermicompost

S.NO	INITIAL HEAD h1 (cm)	FINAL HEAD h2 (cm)	TIME INTERVAL t (sec)	INFILTRATED WATER (ml)
1.	100	80	30.48	75
2.	80	60	68.60	72
3.	60	40	115.06	76
4.	40	20	170.55	70
5.	20	0	242.61	72
AVERAGE =				73

Fig 5. 50% of Vermicompost

DAP: 68 ml of water is infiltrated when DAP is added to soil at duration of 26 min 37 sec. So the result on adding DAP is not effective.

Complex: When complex is added to soil, the pores in the soil get clogged. Complex cannot be used since the water does not penetrate into the soil.

Cow dung: Dry cow dung is collected and sieved into small sized particle. When cow dung is added to the soil, the infiltration of water gets reduced and so cow dung cannot be used.

Urea: When urea is added, the amount of infiltration of water into the soil is shown if Fig 6. Total time taken for infiltration is 21min 17sec. Since the time taken for infiltration is more urea cannot be used.

S.NO	INITIAL HEAD h1 (cm)	FINAL HEAD h2 (cm)	TIME INTERVAL t (sec)	INFILTRATED WATER (ml)
1.	100	80	106.25	78
2.	80	60	293.51	70
3.	60	40	599.17	74
4.	40	20	1097.39	72
5.	20	0	1277.78	70
AVERAGE =				72.8

Fig 6. 25% of urea

ii. Field Test

Experimental Analysis: A drum capacity of 50ltrs with holes randomly at the bottom and the soil is filled in the drum. Water is poured and left for stagnation more than an hour, after that vermicompost is spreaded at the top. The time taken for infiltration is 35min 53sec.

Scale up Study:

A field area is selected and water is allowed to stagnant within that area. Time duration is noted with and without adding vermicompost.

5. Conclusion: The result obtained during lab test was implemented in the field and it is found that the penetration of water is increased by adding vermicompost. The test conducted with addition of vermicompost gives better result and it also helps in recharge of ground water by increasing the water table level.