7th International Conference on Recent Development in Engineering Science, Humanities and Management
National Institute of Technical Teachers Training & Research, Chandigarh, India (ESHM-17)
3rd June 2017, www.conferenceworld.in ISBN: 978-93-86171-26-9

A PERFORMANCE EVALUATION OF GROUNDWATER RECHARGE FILTER

Purender Sharma[1], Deepak Hooda[2], Dr. Manjeet Bansal[3]

[1]M.Tech Scholar, [3]Professor and Head, Department of Civil Engineering,
GZS College of Engineering, Bathinda (India)
[2]M.Tech Scholar Department of Civil Engineering, NIT Kurukshetra (India)

ABSTRACT

Collection of rainwater runoff and driving it into the groundwater is the need of the hour to recuperate the ground water table. Since collected contains many types of impurities, these must be passed over filter so as to protect groundwater from pollution. As the filter is prone to clogging cleaning and maintenance of filter is necessary. This needs performance assessment of filter. ALaboratory experiment is conducted in a rectangular column to evaluate the performance of the partially clogged filter unit consisting of coarse sand (CS) supported by gravel (G) and boulders (B) layers. Coarse sand (CS) of particle size 0.82 mm of thickness 50 cm in the top layer of the filter system and having different concentrations of clay and algae were used for the experimental study. The performance was evaluated in terms of recharge rates. The results indicated that 90 % suspended solids were entrapped in the upper 10 cm layer of CS. Results reveal that increase in concentrations of clay in water and algae over thefilter, reduce its efficiency.

Keywords: Clogging, Coarse Sand, Groundwater, Recharge Rate, Run-Off.

I. INTRODUCTION

Water recharge rate is considered as a vital soil property that can significantly affect the environment. Water quality such as water with organic impurities and inorganic impurities influence the water recharge rate into the soil. Ground water is utilized in meeting around 60% of irrigation demand and 80% of drinking water requirements in India. Due to excessive use groundwater table is declining at an alarming rate in about 15% of India's geographical area. Water tables in fresh groundwater regions of the north- western parts of India, especially in Haryana and Punjab, have fallen at a yearly rate of 25-70 cm over the traverse of the last 2-3 decades and threatening the sustainability of agriculture due to escalation in pumping costs, deterioration in groundwater quality and associated socio-economic and environmental factors. Various options for sustainable water supply in urban India are augmentation of water supply through rainwater harvesting, conservation and groundwater recharge.The fast recuperation of ground water table is possible by injection through rainwater harvesting. The injectable water may contain many types of impurities, these must be passed over filter so as to protectground water from pollution. As the filter is prone to clogging cleaning and maintenance of filter is necessary. This needs performance assessment of filter. The objective of the study is to evaluate the performance of filter with different concentrations of clay in runoff under various degree of clogging of filter with algae.

ISBN: 978-93-86171-26-9

II. EXPERIMENTAL SETUP

The laboratory study is conducted in the rectangular column of size: 20cm x 16cm x 120cm (B x W x H) and having provision of regulated water inflow and free outflow as shown in Figure 1. Inlet is provided in the upper portion of the column to maintain a constant hydraulic head manually during the test run. Outlet is provided at the bottom of column to drain out filtrate water. Measuring bucket is provided at the bottom of the column to measure filtrate water from the outlet. The column is then filled up to 10cm mark from bottom with boulders (passed from 40mm size IS sieve) and above that, gravels (retained on 12.5 mm size IS sieve; thickness = 10 cm) are filled up to 20cm mark from the bottom of the column. The coarse sand having particle size 0.82 mm (Thickness = 50 cm) is filled up to 70cm mark of scale from the bottom. Thus, remaining 50 cm height of the column is used for water head.

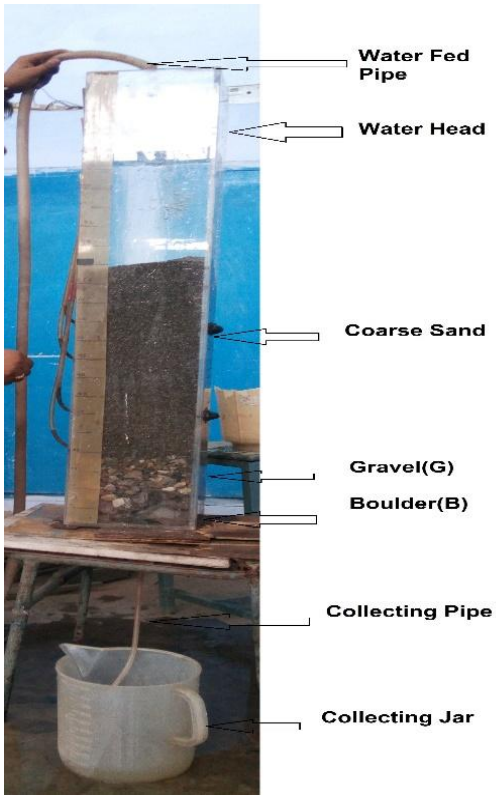

Figure 1. Experimental column used in the laboratory study

III. EXPERIMENTAL PROCEDURE

The prepared artificial water having differentconcentration of clay content and algae in runoff was prepared. The setup is prepared to practically ensure the actual storm water run-off conditions. It was observed that the first storm generates more impurities in run-off water than the succeeding ones. Synthetic water was preparedusing clay sieved through 0.075mm sieve having different concentration from 5-20 mg/l and sun dried algae with different concentrations for the laboratory tests. The prepared synthetic water was fed from the top of the rectangular column up to desired head. The setup required cleaning for the next reading due to clogged impurities.

ISBN: 978-93-86171-26-9

IV. RESULTS AND DISCUSSION

Effect of water head on recharge rate is analyzed in the case of clear water, water containing different concentration of clay and algae and water containing mixture of both clay and algae. laboratory experiments are conducted to find out the relationship between recharge rate and water head over the filter. Experiment results are discussed below.

4.1 Estimation of Recharge Rate Using Graph

The variation of Recharge Rate w.r.t. varying water heads over the surface of filter is shown below. These graph shows that the Recharge Rate increases with increase in water head over the surface of filter.

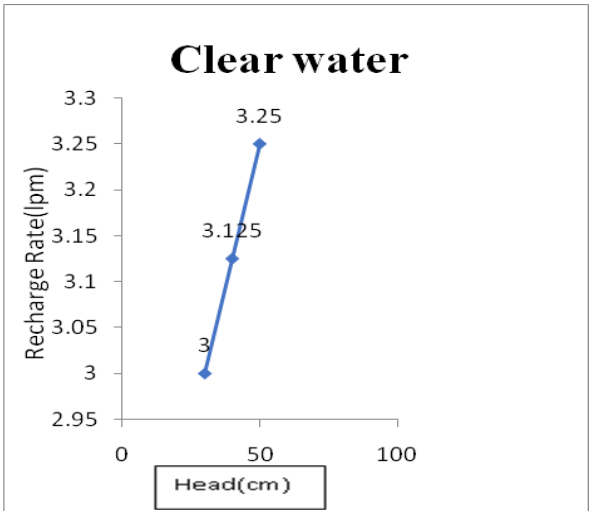

Fig. 2: Recharge Rate versus head curve for the clear water

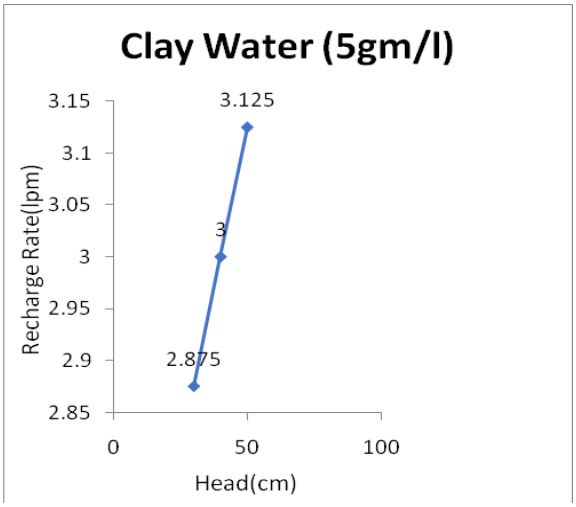

Fig. 3: Recharge Rate versus head curve for the clay water(5gm/l)

ISBN: 978-93-86171-26-9

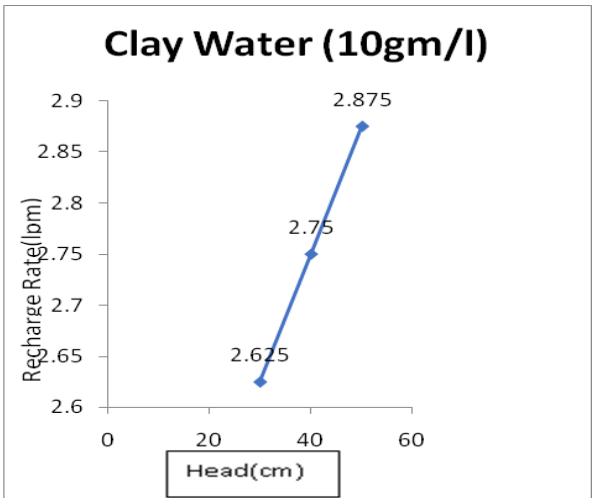

Fig. 4: Recharge Rate versus head curve for the clay water(10gm/l)

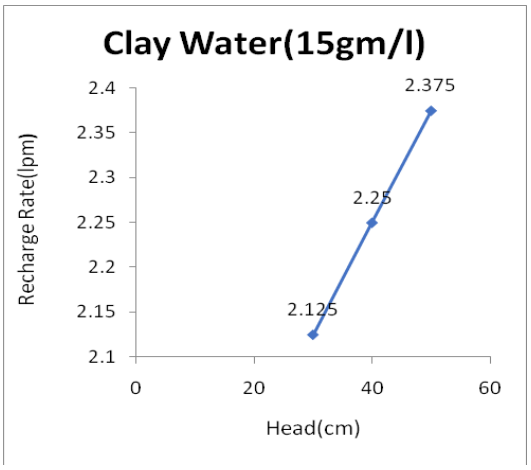

Fig. 5: Recharge Rate versus head curve for the clay water(15gm/l)

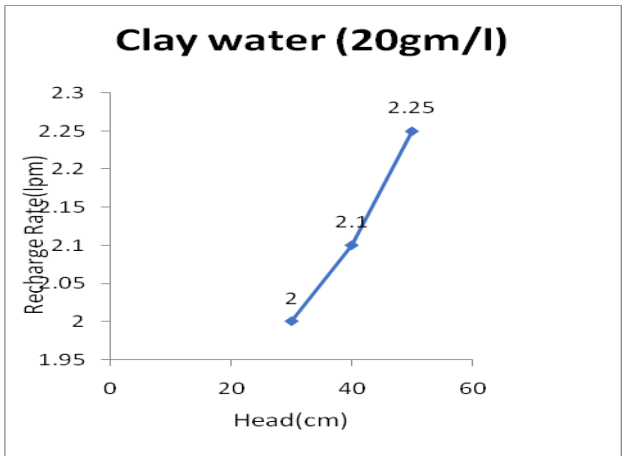

Fig. 6: Recharge Rate vs head curve for the clay water(20gm/l)

ISBN: 978-93-86171-26-9

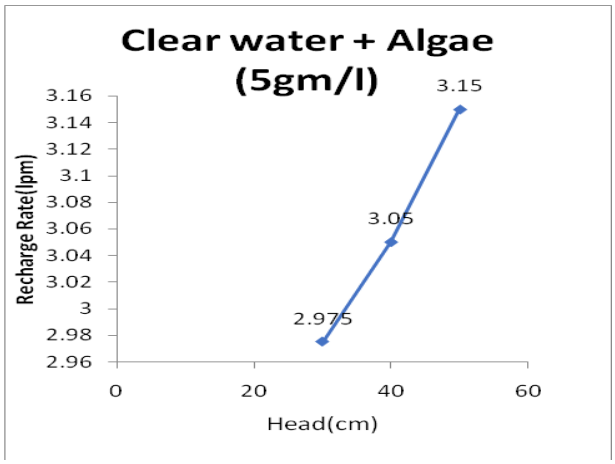

Fig. 7: Recharge Rate vs head curve for the clear water+Algae(5gm/l)

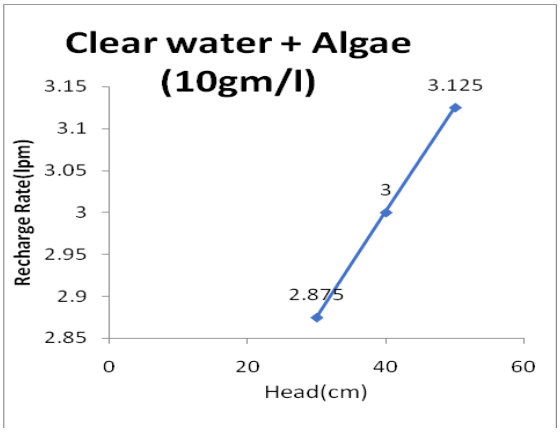

Fig. 8: Recharge Rate vs head curve for the clear water+Algae(10gm/l)

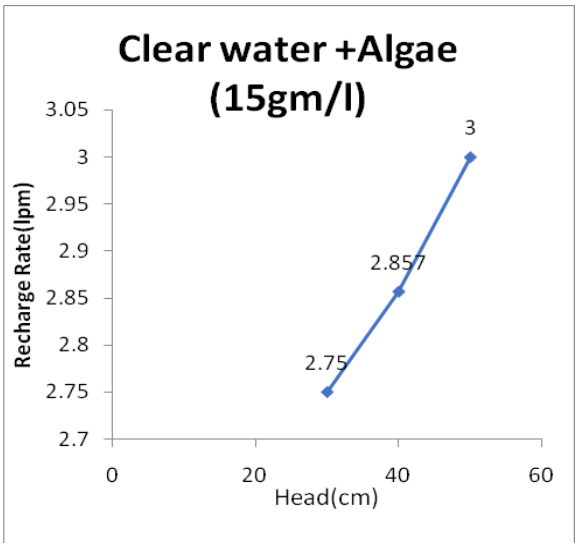

Fig. 9: Recharge Rate vs head curve for the clear water+Algae(15gm/l)

ISBN: 978-93-86171-26-9

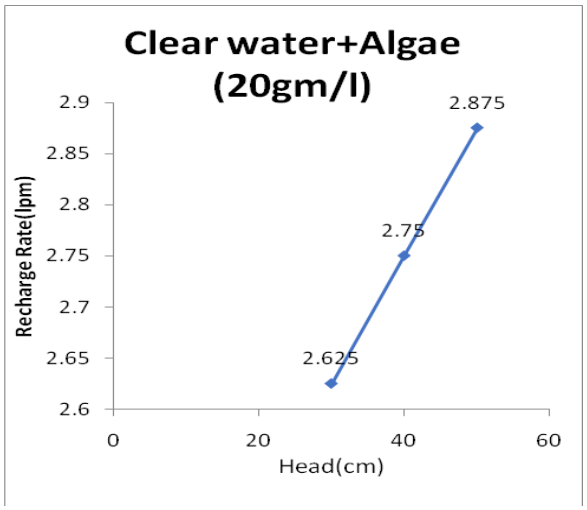

Fig. 10: Recharge Rate vs head curve for the clear water+Algae(20gm/l)

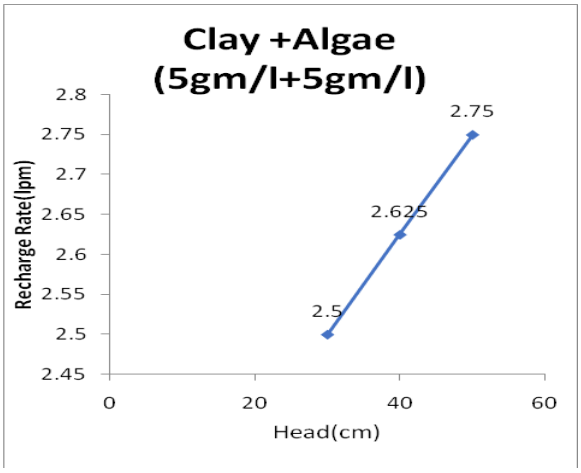

Fig.11: Recharge Rate vs head curve for clay+ Algae(5gm/l each)

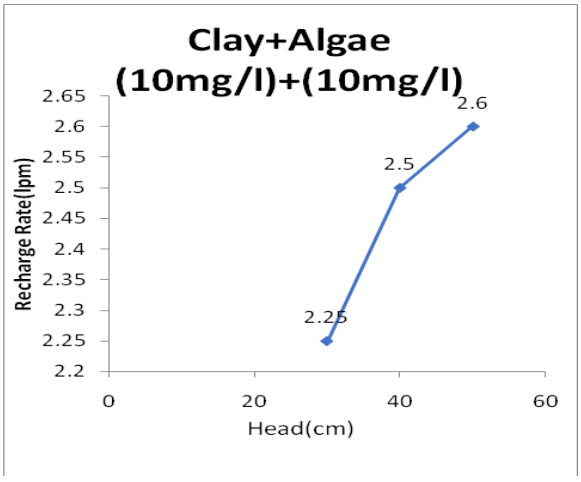

Fig.12: Recharge Rate vs head curve for clay+ Algae(10gm/l each)

ISBN: 978-93-86171-26-9

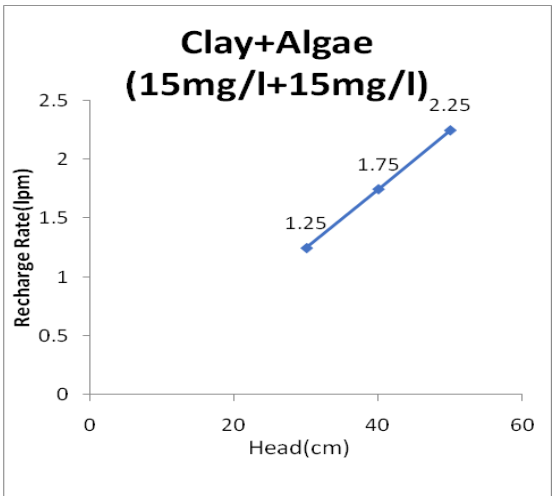

Fig.13: Recharge Rate vs head curve for clay+ Algae(15gm/l each)

V. CONCLUSION

- Recharge rate is increases with increase in water head over the surface of filter.
- Recharge rate is maximum in case of clear water and it goes on decreasing as the impurities (clay contents) are increasing.
- 90% of impurities were entrapped in the top 10 cm layer of CS.
- The performance of stormwater infiltration systems is highly dependent on the formation of clogging layer at the filter.
- In case of water mixed with Algae, the Recharge rate is slightly less than that of clear water but more than the water containing clay impurities.

REFERENCES

[1] CWC, 2007, Water and related statistics. Central Water Commission, Ministry of Water Resources, Government of India.

[2] Clark, S. E., December 1997, storm water runoff treatment by filtration: a pilot-scale study, dissertation research proposal.

[3] Jain, P., 2013, Evaluation of Medium Sand-mixed storm water rectangular filtration System for Ground Water Recharge Wells, M.Tech. dissertation, N.I.T. Kurukshetra.

[4] Kaledhonkar, M. J., Singh, O. P., Ambast, S. K., Tyagi, N. K. and Tyagi, K. C., 2003, Artificial groundwater recharge through recharge tubewells: a case study. Inst. Eng. (I) J. – AG, 84, 28–32.

[5] Kambale, J. B., Sarangi, A., Singh, D. K. and Singh, A. K., 2009, Performance evaluation of filtration unit of groundwater recharge shaft: laboratory study. Curr. Sci., 96, 471–474.

[6] Kumar, Satyendra, Kamra, S. K., Yadav, R. K. and Sharma, J. P., August 2012, Evaluation of sand-based storm water filtration system for groundwater recharge wells, Current science, vol. 103, no. 4.

[7] Singh, K. K., & Jain, P. (2015). Performance Evaluation of Filtration System for Groundwater Recharging

ISBN: 978-93-86171-26-9

Well in the Presence of Medium Sand-Mixed Storm Water. Performance Evaluation, 1, 23289.

[8] Siriwardene, N. R., Deletic, A. and Fletcher, T. D., 2007, Clogging of storm water gravel infiltration systems and filters: insight from a laboratory study. Water Res., 41, 1433–1440

[9] Taneja, D. S. and Khepar, S. D., 1996, Effect of artificial ground-water recharge on aquifer parameters using cavity well. Ground Water, 34, 335–340.

[10] Thomas, Roger L., 1968, Coarse Filter Media for Artificial Recharge. Illinois State Water Survey, Urbana, Report of Investigation 60.

[11] Yadav, A., Sonje, A., Mathur, P., & DA, J. (2012). A review on artificial groundwater recharge. Int. J. Pharm. Biosci, 3(3), 304-311.