STUDY ON AQUIFER PARAMETER IN BASALTIC ROCK WITH THE HELP OF PUMPING EXPERIMENT METHOD USING MODFLOW SOFTWARE IN PURNA RIVER BASIN

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Abstract

The occurrences of groundwater and movement of groundwater is major question to development and working process. The aspect of water run and supply are temporally related to hydrological issue, generally groundwater flow through aquifer but there is variation in rock composition and temperature due to the recharge and discharge of condition which are depend on aquifer flow, geological and hydrological information provide us influential information about the subsurface strata. Study of shallow earth provide major information necessary to answer these questions is not continuously, spring which discharge ground water table indicates study of subsurface in hydrological way. In presence condition detected on the basis of Transmissivity (T) storativity (S). There are many methods use by accurate parameter of aquifer like water analysis, hydrological parameter, pumping aquifer experiment. These parameters are projected execution experiment on aquifer well samples carried in the laboratory. Need to collect the analyzing data on borehole, open well, reservoir and its boundary.

Keyword: Groundwater influential, well pumping experiment mudflow software.

Introduction

Common method using in-situ experiment to fall and rise ground water level with respected time and measurement time with aquifer efficiency. (Singh V.S Gupta C.P 1986) Alternate processes of fall and rising experiment to make causes to pumping well, ground water level are fluctuated and rock strata may be cracked. (Javandel and Witherspoon, 1983) Estimate of aquifer parameters is an influential basis to groundwater resources, numerical, simulation, development, protection, and evalution of resources. Measurement of groundwater aquifer using borehole, pumping well, reservoir, these technique provide the accurate parameters analysis report of groundwater aquifer in condition of fall stream rising stream. (Hanthus MS 1966) Define the

aquifer mapping is a scientific process, wherein a combination of geologic, geophysical, hydrologic and chemical field and laboratory analyses are applied to characterize the quantity, quality and sustainability of ground water in aquifers. Systematic aquifer mapping is expected to improve our understanding of the geologic framework of aquifers, their hydrological characteristic. (Theis CS 1935) was first to propose method to evaluate aquifer parameters from the pumping test on a bore well in a confined aquifer. It is essential to know the transmissivity (T ¼ Kb, where b is the aquifer thickness; pumping flow rate, Q ¼ TW (dh/dl) flow through an aquifer) and storativity (confined aquifer: S ¼ bSs, unconfined: S ¼ Sy), for the characterization of the aquifer parameters in an unknown area so as to predict the rate of drawdown of the groundwater table/potentiometric surface throughout the pumping test of an aquifer. (K. Moharir et al. / Geoscience Frontiers xxx 2017). The determination of aquifer's parameters is an important basis for groundwater resources evaluation, numerical simulation, development and protection as well as scientific management. For determining aquifer's parameters, pumping test is a main method. A case study shows that these techniques have been fast speed and high correctness. The results of parameter's determination are optimized so that it has important applied value for scientific research and geology engineering preparation.

Fig 1: Map of the Amravati District Showing Location of Walgaon -Achalpur Village .

Stratigraphy

Following table shown by Geological succession of study area.

Table 1: Showing Geological Succession of Walgaon- Achalpur village. Amravati District

Age	Formation	Lithology
Pleistocene Boulder layer	**Alluvium**	**back cotton Soil, Silt, Clay, Recent**
……..Unconformity…….		
Upper Cretaceous To Eocene	**Deccan Trap**	**Basalt**

……Unconformity……		
Upper Cretaceous	**Lameta**	**Limestone Clay, Sandstone**
……Unconformity……		
Midddle Cretaceous To Permian	**Gondwana super group**	**Sandstone**
……..Unconformity……		
Proterozoic	**……**	**Feldspathic Gneiss**

Location of the area

The study on the based of hydrogeological data obtained for large-diameter dug wells tapping unconfined aquifers in various parts of Maharashtra and considers the potential of the above five groups as aquifers. The area under study is forming a part of the Achalpur, Bhatkhuli and Chandur Bazaar talukas of Amravati district, Maharashtra., India. located close to the western margin of the Deccan traps terrain. An area of 722 sq.km lying between north latitude 21˚ 0’: 21˚ and east longitude 77˚ 30’: 77˚ 45’ falling in Survey of India Toposheet .55G/12 on 1:50,000 scale was covered. The area comprises of parts of Achalpur, Bhatkhuli and Chandur Bazaar talukas of Amravati district. Mostly cover region are from Walgaon road to Achalpur talukas. Achalpur City is situated at a height of about 368 meters (1200') above sea-level. It lies more than 48.278 km. (30 miles) to the north-west of Amravati, Sapan and Bichan which flow through the town. The east to west monsoon (during middle June to September) contributes more than 70% of the rainfall. Rainwater is the main source for recharging of groundwater. The location map of the study area is shown in Fig.1

Methodology

Pumping experiment method is a very modest technique. An observation well, which is selected in the aquifer system has been pumped and the drop of groundwater level is calculation in the pumping test well or in the close pumped well at continuous interval. (Hantush and Jacob, 1955;) As the pumping experiment stops, the groundwater level in the observation well increases. These reported groundwater levels are used to control the aquifer parameters characteristics (Fig.2)

Pre-pumping measurements It is very essential to make measurements of water levels in the pumping as well as in the observation wells. (K. Moharir et al. / Geoscience Frontiers xxx 2017).Measurement of water level regular interval half an hour. In case appreciable difference is noted, the sufficient time is given to get water level stabilized. In some case found that measurement of water level prior to experiment is carryout for couple days. (Thiem, 1906; Theis, 1935) Gives the trend of variation in the water level which can be used for correction of falling obtained during the experiment. Therefore, shown by continues experiment change water level less and less. At the latest stage the interval of measurement is increased. (Cooper and Jacob, 1946) The most practical time intervals are given in Table 1. Similarly, the water level measurements are carried out in the wells after the pumping stops. (Javandel and Witherspoon, 1983) During the recovery period also the water

level rises rapidly during the initial hours. Hence the measurements of water level in the initial hours should be carried out at short intervals. The measurement of the water level should be continued till near complete recovery occur.

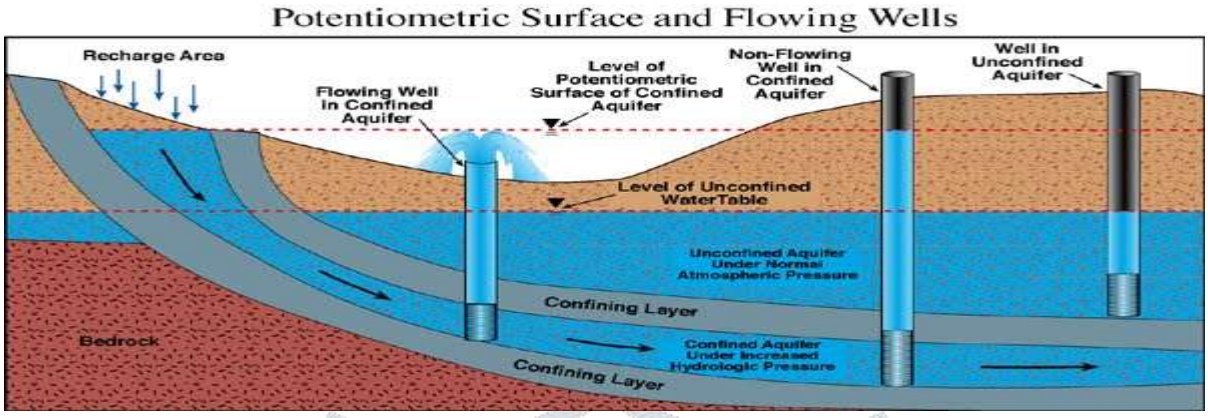

Fig 2. Showing hydraulic parameters of aquifer of groundwater.

Time to achieve such condition depends on the type of aquifer and the pumping rate. (K. Moharir et al. / Geoscience Frontiers xxx 2017). Therefore, it is difficult to decide in forehand how long experiment should continue. However, during the test as the increase in drawdown reduces considerably the test can be stopped. In confined aquifer such condition is reached soon whereas in unconfined aquifer it takes little time. Shown in following table.

Table 2. showing range interval between water level measurement of pumping well.

Pump Time started (minute)	Intervals time (minute)
0-5	1
5-60	6
60-120	22
More than 120	60

The MODFLOW program is based on finite difference method. Groundwater flow within the aquifer is simulated in MODFLOW using block-centered finite-difference approach. (K. Moharir et al. / Geoscience Frontiers xxx 2017) Layer can be simulated as confined, unconfined, or a combination of both. To use MODFLOW, the region to be simulated must be divided into cells with a rectilinear grid resulting in layers, rows and columns. Files must be prepared that contain hydraulic parameters (hydraulic conductivity, transmissivity, specific yield, specific storage, etc.), boundary conditions (location of impermeable boundaries and constant heads) and stress (pumping wells, recharge from precipitation, rivers, drains, evapotranspiration, etc.). (K. Moharir et al. / Geoscience Frontiers xxx 2017) Subsequently, adjustments of transmissivity values and recharge rates over the entire aquifer are undertaken by trial and error to obtain hopefully ever improving agreement between the simulated and observed hydraulic head values. Such a manual approach is often a struggle for lack of systematic direction as to the path to a successful calibration. In this study, we present a structured procedure that can expedite the commonly tedious and timeconsuming manual calibration process.

Geological and hydro geological setting basalts are devoid of primary openings but possess secondary openings in the form of fractures and joints. unconfined conditions in the weathered basalts that outcrop at the surface. Groundwater is also present in the basalts under semi-confined to confined conditions. The groundwater in the study is extracted by either dug wells or bore wells. In areas where the water table is shallow (3.0 -18.0 m in depth), dug wells are more popular due to their lower cost The bore wells are drilled in basalts where the water level is deeper, with depths varying from 40.0 to 50.0 m. The dug wells are replenished by shallow aquifers while the bore wells are from deep aquifers. There are shown by model properties in following table.

Table 3. Shown model properties in hard rock layer measurement.

SR.NO	Model properties	Layer I hard rock
1	Hydraulic conductivity in longitudinal direction, Kx, m/s	0.000015
2	Hydraulic conductivity in lateral direction, Ky, m/s	0.000015
3	Hydraulic conductivity in vertical direction, Kz, m/s	1Ee6
4	Specific yield, Sy 0.0022	0.0024
5	Effective porosity	0.15

To assess aquifer parameters, pumping test is the finest available method. This test includes removing water from a well at a controlled rate and detecting the water level fluctuations in the pumped well and/or in one or more observation wells, with respect to time (Theis: 1935 Singhal Gupta: 1999) During the past few periods, to analyze the pumping test data researchers have proposed several different methods and estimate the aquifer parameters (Thiem, 1906; Theis, 1935;)(Cooper and Jacob, 1946) (Hantush and Jacob, 1955;) (Hantush, 1960, 1966 (Javandel and Witherspoon, 1983) Raj, 2001).

Results & Discussion

The results of pumping Experiment data show that in every basin, the transmissivity and permeability values are near about similar to one another detecting free movement of groundwater within the basin limits with the presence of permeability barrier towards the 'high' where the values reduce suddenly. These values to be helpful in further determining the boundaries of the one basin which different from the other basin. Considering the free movement of groundwater within the limits of basin, well location can be more accurately identified based on the shapes of the contours. The result of the pumping experiment data shows that limited of groundwater prospects in particular region which is certainly needs to planning and management of the available water resource. In this method, (Cooper and Jacob 1946) suggested an easy method to determine aquifer parameters. The method does not require curve matching. The time-drawdown data is plotted on semi-log paper (time on log axis and drawdown on linear axis). The additional condition required to use this method of experiment should be conducted for many times. The value of it should be less than 0.001. A straight line is

drawn through the data points and the slope (Ds) of the straight line is determined. The time (t0) is also noted where the straight line intercepts the time axis (i.e. at s ¼ 0) πΔ

T =2.3 Q/(4 πΔs)

S = 2.25 Tt/r.r

Hantush's method

The flow to a well in a leaky aquifer which is anisotropic on the horizontal plane can be analyzed with a method that is essentially the same as the Hantush method for confined aquifers with anisotropy on the horizontal plane There is, however, one more unknown parameter involved, the leakage factor L, which is given by Hantush (1966) as

$$L = \sqrt{(KD)nc}$$

Aquifer parameters (T and S) The aquifer parameters, transmissivity 'T' and storage coefficient i.e., specific yield (Sy), were estimated through dug well pumping tests, as dug wells in the area are common means for domestic use and irrigation purpose. Duration of dug well pumping test varies from 40 to 400 min. The recovery (90%) data was used for interpretation of the present data. The pumping experiment result. Transmissivity values were found to be varying between 2.6 m3 /day and 104 m3 /day. Storage coefficient values vary from 0.001 to 0.01 . Transmissivity values increase towards valley portion from the topographic high and also increases towards west. The storage coefficient values of dug wells and bore wells pumping test indicate that the aquifer is a confined nature. The topographic high in the eastern part is characterized by poor groundwater potential.

Conclusion

This study can be used for aquifer mapping to systematic planning of groundwater management to Thesis with Jacob correlation, Jacob's semi-log, Hantush (log-log), Papadopulos and Cooper (log-log) and Papadopulos and Cooper techniques. The estimation of aquifer parameters is vital for evaluating and managing groundwater resources. The recent trend in increased abstraction from the Deccan rock aquifer to meet, in particular, the rising demand for irrigation is likely to continue. This has complex concern in Indian country that present groundwater concept from the shallow aquifer in certain areas may be exceeding that which is ecological from limited groundwater resources and that ground water levels are declining as a result.

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