Using Aquifer test pro 2016 for estimating Groundwater hydraulic Parameter for Sustainable yield

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Abstract: *Groundwater is an important resources to mankind and its preferable to surface water due to the fact that it is not easy contaminated. The estimation of aquifer characteristic such as hydraulic conductivity and specific yield is very paramount in understanding groundwater flow and as well as used in the design of groundwater well (boreholes) in order to attain sustainable yiel . The aim and objective of this paper is to use aquifer test pro 2016 to estimate aquifer characteristic from pumping test carried out on site at University area, and compare the hydraulic conductivity result based on the Theis with Jacob correction formula, Neuman model and Boulton model. the value of hydraulic conductivity from the three methods is 3.59m/d, 2.042m/d, 1410m/d with average value of 471.8m/d. The analysis demonstrated that Newman method is more suitable than theis with Jacob correction method and Bolton method for Estimation of Groundwater hydraulic parameters of the weathered aquifer in the study area.*

Keywords: *Aquifertest pro 2016, Hydraulic Conductivity, Pumping test, Specfic yield, Sustainable yield.*

I INTRODUCTION

Groundwater distribution may generally be classified into zones of aeration and saturation. The uppermost zone, which occurs immediately below the land surface, contains both water and air; it is referred to as the aeration or unsaturated zone. Below the unsaturated zone is a zone in which all interconnected openings contain only water and which is referred to as the saturated zone. The water table is the level near the upper part of the saturated zone at which water occurs under a pressure equal to the atmospheric pressure. Water in the saturated zone is the only underground water that is available to supply wells and springs and is the only water to which the name groundwater is correctly applied. . Groundwater is the major source of water supply especially in arid and semi-arid areas where surface water is limited.

Permeability is the ability of a rock or unconsolidated sediment, to transmit or pass water through it [3]. It is measured by the coefficient of permeability or as hydraulic conductivity. Transmissivity is another physical concept of describing groundwater flow. It has a simple mathematical relationship with permeability. Some researchers have endeavored to measure aquifer characteristics as reported in the Literature review. Examples include [2], [5], [6], [1].

Shi Zhiyuan determined hydrogeological parameters through genetic algorithm with pumping test and compared the parameters with that of wiring method and direct graphic method. Results show that computing drawdown of request parameters obtained by genetic algorithm matches with the actual drawdown of request parameters [7]

At present, the pumping test method is the main method to determine the parameters of the aquifer. In these methods, the steady method and transient flow method can be used in calculating the parameters of phreatic water. The Dupuit and Thiem formula are adopted by phreatic water steady well flow, and the imitation of Theis formula, Boulton model, Neuman model, the water stage recovery method are applied into partially penetrating well flow.

Currently, Aquifer Test software which calculates the parameters of the pumping test by computer is developed by Waterloo Hydrogeologic Incorporated, H. Jiang [4]. This software is specifically used for the analysis of data of pumping test, data processing, analysis and research of obtaining parameters graphically. It can be applied to calculate the data of pumping test and complete the display and printing of the process and result of getting parameters. The Aquifer parameter was determined by using the Aquifer Test pro 2016 software and on the basis of imitation of Theis formula, Neuman model, Boulton model by using the data of pumping test in a weathered formation of university of Ilorin bore well.

II PUMPING TEST DATA

The pumping test exercise was carried out on a single well within the University of Ilorin, with a constant discharge of 1.41667l/s. the pumping well has a depth of 32m. Diameter of 0.254m, the aquifer/overburden thickness is 10m and the original static water level is 5.2m. the duration of pumping span for 50minutes.

TABLE II
DETAILS OF PUMPING WELL

s/N	Type	X(m)	Y(m)	Elevation	Bench mark	Penetration	R(m)	L(m)	b(m)	r(m)
1	Pumping					Fully	0.127	10	10	

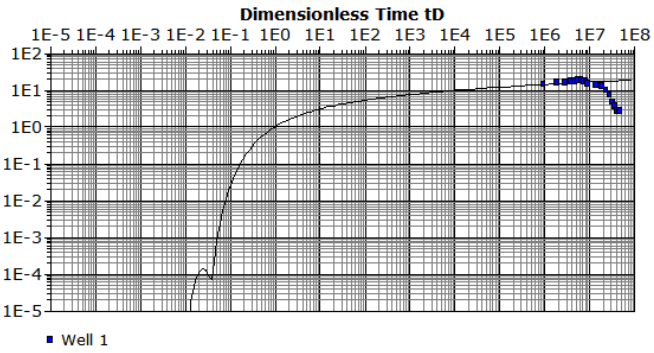
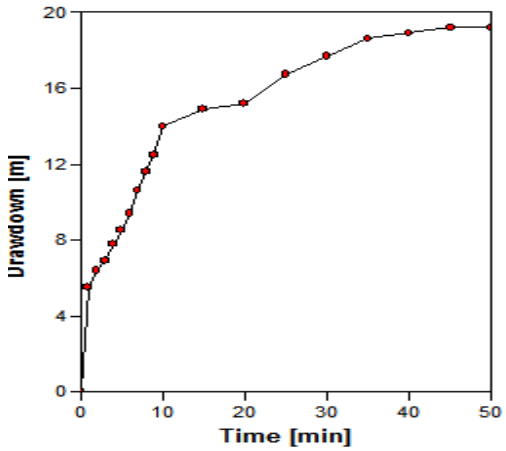


Fig 1 Time-drawdown graph of Pumping well

TABLE I
PUMPING TEST DATA FOR SINGLE WELL

Time(mins)	Pumping W.L(m)	Drawdown(m)
0	5.2	0
1	10.7	5.5
2	11.6	6.4
3	12.1	6.9
4	13	7.8
5	13.7	8.5
6	14.6	9.4
7	15.8	10.6
8	16.8	11.6
9	17.7	12.6
10	19.2	14
15	20.1	14.9
20	20.4	15.3
25	21.9	16.7
30	22.9	17.7
35	23.8	18.6
40	24.1	18.9
45	24.4	19.2
50	24.4	19.2



III AQUIFER PARAMETER ESTIMATION USING AQUIFER TEST PRO 2016

A single well was set up in Aquifer Testpro 2016. Specific settings of each well were shown in figure 1. Select constant in Discharge window and type 4.1667; select well 1 in Water Levels window and type the data of time-drawdown. Then select these three solving methods, Theis with Jacob correction, Neuman, Boulton, and type-curve with professional judgment.

A. Determination of parameters based on Theis with Jacob correction.

Fit curve by choosing Theis with Jacob correction in the Analysis window. Adjusted curve is shown in figure 3. The result of the type curve is: T=35.9 (m^2 /d), S =1.69 x 10^{-6} and the calculated value of K is 3.59(m/d).

fig 2: fitting curve using the theis with jacob's correction

B. Determine the parameters on the basis of Neuman

Fit curve by choosing Neuman in the Analysis window. Adjusted curve is shown in figure 4. The result of the type curve is: T=2.42 m^2/d, and the calculated value of K is 2.042 (m/d). the specific yield is 9.9 x 10^{-1}, Kv/Kh =8.11x10^{-2}

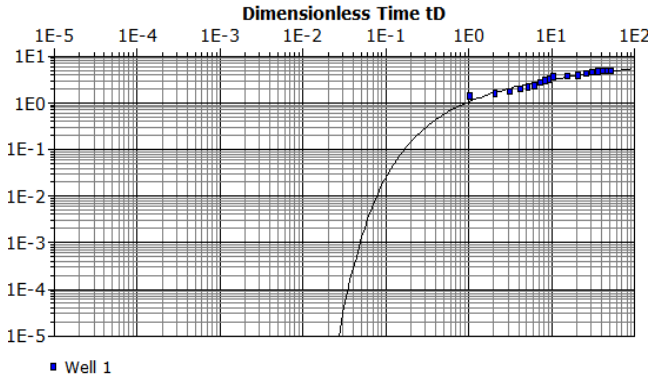


Fig 3: fitting curve using the Neuman method

C Determine the parameters on the basis of Boulton formula

Fit curve by choosing Boulton in the Analysis window. Adjusted curve is shown in figure 5. The result of the type curve is: $T=1.41\times10^4$ (m^2 /d), and the calculated value of K is 1410 (m/d). specific yield is $1x\ 10^2$

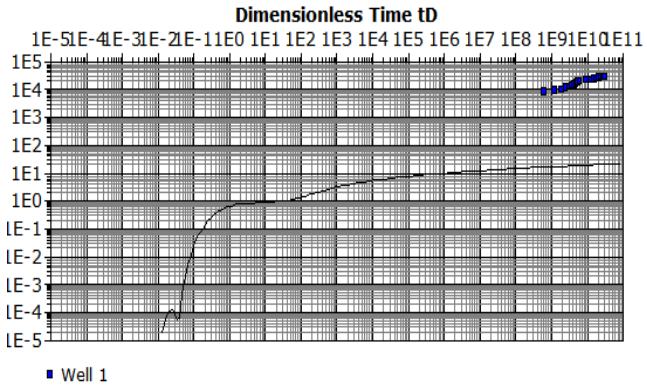


Figure 4: fitting curve using the Boulton formula

IV RESULT AND DISCUSSION

The Newman well formula requires a basement aquifer or generally a unconfined aquifer. The aquifer is homogeneous, anisotropic and constant gravity specific yield. The Bolton well formula requires the weathered aquifer to be homogeneous and isotropic. For this analysis, the theis with Jacob correction method is actually not suitable, since the model assumption is confined, while a weathered formation is unconfined. In summary the newman method is considered to be the best method compared to the other two. Therefore very suitable when analysing unconfined aquifer. Also the value of specific yield is 9.9×10^{-1}, Kv/Kh $=8.11\times10^{-2}$ are important parameter when modeling unconfined condition. The average values of hydraulic conductivities is 471.87m/d

ACKNOWLEDGMENT

The authors are thankful to all friends and in particular to Dr S.A raji in the success of this paper and would like to thank the anonymous reviewers for their comments which were very helpful in improving the quality and presentation of this paper.

V CONCLUSION

In conclusion the method that should be adopted when estimating the hydrogeological parameters of an unconfined aquifer in a sedimentary basin or weathered formation in a basement complex is the newman method. Since the other two methods cannot estimate the specific yield of an unconfined aquifer which is important to quantify flow in this region

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