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Pumping Test Analysis Of Large Diameter Wells In Pulang River Basin Cuddaph District

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Abstract:
Pumping tests were carried out in a few selected open wells in a pulang river basin Cuddapah District. The wells are tapping water from weathered, fractured zones and river alluvium. Transmissivity storage coefficient and specific capacity are calculated based on Papadopulas-cooper and slichter's method. From the analysis it is concluded that though there is considererable variation in the aquifer characteristics from one well, to another well, the general pattern seems to be fairly uniform. The specific capacity of the open wells increases as the diameter of the well increases.

1.Introduction

The evaluation of aquifer characteristics is essential in the location and design of wells and for utilization of groundwater resources. Aquifer characteristics play a crucial role in the determination of wells spacing and reservoir characteristics, Kruse man and De Ridder (1970), singhal (1977). The pumping test is one of the most important techniques available to the hydro geologist (Renard 2005). Properly carried out tests can give information ranging from the efficiency of a borehole to the aquifer properties (such as Transmissivity, storability, aquifer geometry) or the influence of overlying strata

The analysis of the hydraulics of wells for the evaluation of groundwater potentialities by pumping tests falls in the category of groundwater hydrology. This field has been rapidly developed since the publication of the well-known law of flow through porous materials by Henri Darcy in 1856. (1)* This law states that the discharge through porous media is proportional to the product of the hydraulic gradient, the cross-sectional area normal to the flow and the coefficient of permeability of the material. In 1863, Dupuit applied Darcy's law to well hydraulics, using an ideal case of a well located at the center of a circular island.

The Dupuit formula was modified by Thiem [(3)] in 1906 to a form which is applicable to more general problems. Similar formulas were also advanced by Slichter [(4)], Turneaure and Russell [(5)], Israelson [(6)], Muskat [(7)], and Wenzel [(8)]. However, all of these were essentially either modified or specialized forms of Dupuit's relationship. These methods may all be classed together as the "equilibrium method" which applies only to a steady-state condition in which the rate of flow of water toward the well is equal to the rate of discharge of the pumped we

The pulang river basin which includes six sub-basins with a drainage area of about 757 km^2. The rock formation of the study area represents a suite of sedimentary and metamorphic rocks formed during Precambrian times. Lithologically the Cuddapah formations are predominantly argillaceous and arenaceous sequence with subordinate Calcareous sediments. In hard rock areas field conditions often deviate greatly from ideal conditions assumed for developing standard mathematical equations dealing groundwater flow towards well. In view of the heterogeneous nature and as the hydraulic conductivity differs with depth, the aquifer characteristics vary considerably. The problem becomes still more complicated as the classical mathematical solutions are not applicable for open well, because the radius of the pumped well influences the drawdown data. However, an attempt has been made to analyze the pumping test data of large diameter open wells from the hard rock areas of Pulang river basin based on papadopulas – Cooper and Slichter's method.

A pumping test involves abstracting water from a well at a controlled measurable rate and observing the rate of change of the level of water in the well and also nearby observation well. The hydraulic properties of the aquifers can be estimated by various methods of performance tests. Among them, the aquifer test and the well test are the most important tests.

A reliable assessment and management of groundwater potential in any area needs accurate and representative estimation of aquifer parameters. The pumping test is one of the widely practiced methods to determine aquifer parameters. The time drawdown data obtained during the pumping test is matched with model values and, after obtaining the best match, the model parameters are considered to be representative of field parameters. The model becomes a true representative of field situations only if actual field conditions are taken into account. Many of the field conditions are simplified as they cannot be exactly represented through models. It is seldom that exact field conditions are known and, by and large, one arrives at equivalent models representing the complex field situations. One of the boundary conditions in most of the models is that the pumping well has an infinitesimally small diameter. This implies that the effect of well storage is negligible and the entire pumped water comes from the aquifer. However, under many circumstances, the well storage is found to be significant and the estimation of aquifer parameters becomes ambiguous if the well storage effect is not taken into account.

Pumping tests involves measurement of water levels at two stages during discharge and during recovery. Drawdown measurements are taken at short intervals of time during the early stages of pumping and later at long intervals and the same are recorded. The discharge rate is maintained constant throughout the pumping in order to avoid unnecessary complications in computation. Later, the recovery measurements are made similarly.

Slichter (1906), developed an expression for specific capacity of large diameter wells. Many workers Papadopulas – Cooper (1971); Kumaraswamy (1971,1972); Zhadankus (1973); Guptha and Jayaprasadan (1977); have compared the unsteady, steady confined and unconfined radial groundwater flow equation and developed methods for analysis and designing of bore and dug wells in shallow aquifers, based on pumping and recovery test data. Sastry and Janardan (1978) have suggested that in the absence of suitable formula. Papadopulas method can be used for large diameter open wells by keeping low discharge and pumping for larger periods to determine the aquifer parameters.

2.Analysis And Results

Papadopulas – Copper (1967) have given a theoretical solution for analyzing the pumping test data from large diameter wells taking into account the storage capacity of the well. The equation is based on the assumption that aquifer is confined, homogeneous, isotropic, and extensive and the well penetrates the entire thickness of the aquifer, unsteady state of flow at constant discharge rate and well losses are negligible. The assumption that the aquifer is confined is relatively a severe objection on the use of Papadopulas equation for confined aquifers for using this formula in seepage face at well parameter. Therefore, for using this formula in unconfined aquifer the pumping rate should be kept low so that the flow in the aquifer is maintained similarly to flow in artesian conditions.

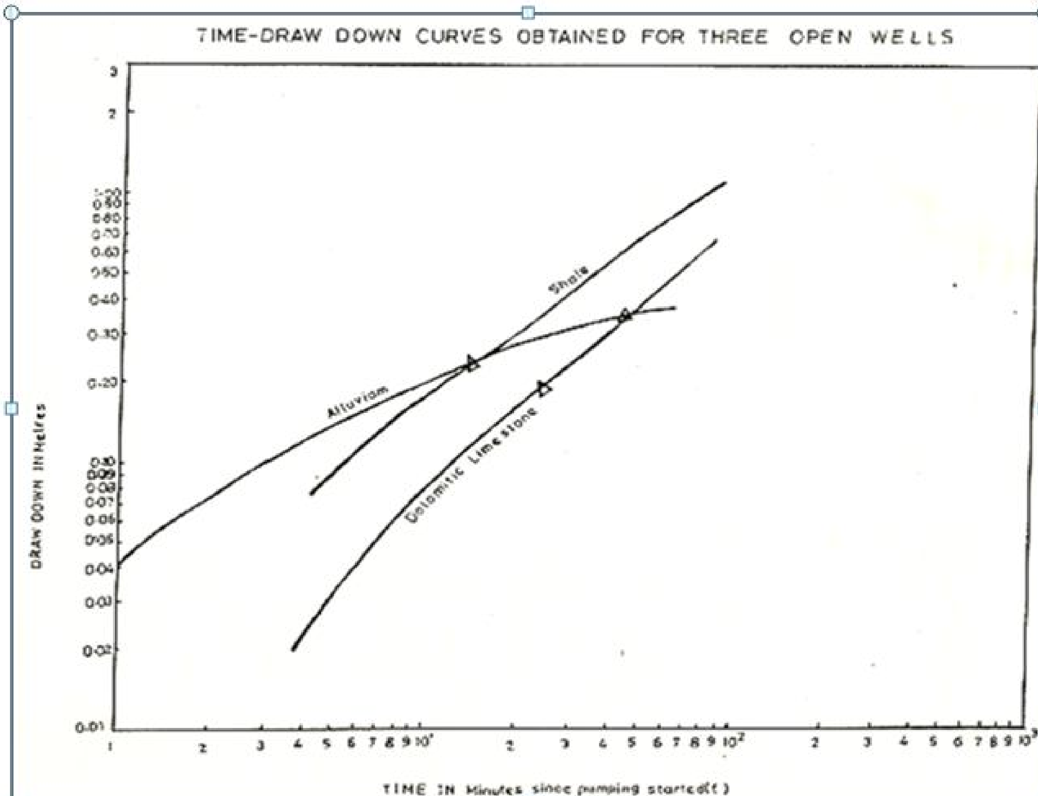

Figure 1

Aquifer tests are conducted in 5 open wells within shales, dolomitic limestones, and alluvium to determine Transmissivity (T), Storage Coefficient (S) and specific capacity

(C). The pumping test data of three wells, representing each shale aquifer, dolomitic limestone aquifer and alluvium aquifer are presented in Tables 1, 2, 3 and plotted in Fig. 1.

The Transmissivity (T) of different aquifers in the regions various from as low as 112 m^2/d in shaly region and is high as $580m^2/d$ in alluvium. In different aquifers of the study area, the high range in the values of T is attributed to the anisotropic nature of the aquifers both in vertical and lateral directions due to differences in the degree of weathering and fracturing in rocky aquifers and varying properties of sand of different sizes, silt, and clay in the case of alluvial aquifers (Table 4). The storage coefficient (S) of the aquifer varies from 0.004 to 0.06 in shales, 0.07 to 0.08 in dolomitic limestones and is 0.10 in alluvium.

According to Trainer et al (1975) 'S' is less than 0.001 in artesian aquifers between 0.001 and 0.1 in leaky aquifers, and more than 0.01 in water table aquifers. This classification finds support in the present study. All the five wells located in the study area receive water table conditions either from alluvial or rocky aquifers.

The specific capacity(C) values for different aquifers vary from 251 to 312 in the shale formation, 322 to 450 in the dolomitic region and 620 in the alluvium region. This variation in percolation rate is attributed to the cross sectional area of the well. These values are mainly dependent on the design of pumping wells, ground water recharge and the time of pumping.

Time Since Pumping Started (Mins)	**Drawndown (Mtrs)**	**Time After Pumping Stoped (Mins)**	**Recovery (Mtrs)**
00	0.00	10	0.00
05	0.08	15	0.85
10	0.16	20	0.79
15	0.23	25	0.73
20	0.29	30	0.68
25	0.35	40	0.61
30	0.42	50	0.55
40	0.56	60	0.51
50	0.67	75	0.47
60	0.79	90	0.44
70	0.91	120	0.38

Table 1: *Aquifer Performance Test Data Of A Open Well In Shale At Rajampet*

Time Since Pumping Started (Mins)	Drawdown (Mtrs)	Time After Pumping Stoped (Mins)	Recovery (Mtrs)
00	0.00	01	0.00
01	0.00	02	0.67
02	0.01	03	0.65
04	0.02	05	0.63
06	0.04	07	0.62
08	0.06	09	0.60
10	0.08	11	0.58
15	0.11	13	0.55
20	0.15	15	0.53
25	0.18	20	0.51
30	0.21	25	0.48
35	0.25	30	0.42
40	0.29	35	0.36
45	0.32	40	0.32
50	0.37	45	0.27
55	0.41	50	0.24
60	0.45	55	0.17
70	0.53	60	0.13
80	0.60	70	0.06
90	0.68	80	0.04
		90	0.01
		100	0.00

Table 2: *Aquifer Performance Test Data Of A Open Well In Dolomite Limestone At Bramhanapalle*

Time Since Pumping Started (Mins)	Drawdown (Mtrs)	Time After Pumping Stoped (Mins)	Recovery (Mtrs)
00	0.00	00	0.00
02	0.10	02	0.09
05	0.12	05	0.21
10	0.24	10	0.38
15	0.28	15	0.45
20	0.40	20	0.47
30	0.50	30	0.56
40	0.56	45	0.62
60	0.64	60	0.66
70	0.68	90	0.68
80	0.70	110	0.70
90	0.73		
110	0.78		
140	0.79		
170	0.81		

Table 3: *Aquifer Performance Test Data Of A Open Well In Alluvium At Atterala*

Well No.	Nature Of Aquifer	Location	Transmissibility T In M^2 /Day	Storage Coefficient S	Specific Capacity C In M^2/Day
1	SHALES	RAJAMPET	112	0.06	251
2	WEATHERED LIMESTONE	BRAMHANAPALLI	235	0.07	322
3	ALLUVIUM	ATTERALA	580	0.10	620
4	DOLOMITIC LIMESTONE	AKEPODU	340	0.08	450
5	SHALE	PULLAMPET	210	0.004	312

Table4: Results Of Aquifer Performance Test Data In The Study Area

3.Conclusion

Pumping test data carried out for open wells have been analysed based on the methods adopted by Papadopulas-Copper for open wells. These results indicate that there is considerable variation in the aquifer characteristics from one well to another well, but the general pattern seems to be fairly uniform. The unit of specific capacity decreases as the diameter of the well increases. To work at the water balance of the area, it is essential to evaluate quantitatively all the factors relating to inflow and outflow of water from the wells by studying hydraulic characteristics of different aquifers of the study area. It is necessary to have a fairly good knowledge of the nature, extent and potentialities of the aquifers in the study area for safe utilisation of the available groundwater resources to an optimum limit in different geological formations.

4.Reference

1. Barker JA, Macdonald DMJ (2000) A manual for BGSPT: programs to simulate and analyse pumping tests in large-diameter wells. British Geological Survey Technical Report WC/00/17.
2. Darcy, Henri, Les Fontaines publiques de la ville de Dijon, Paris, 1856.
3. GUPTHA, C.V.S.Er. and Jayaprasadan, R.Er 1977. Verifications of inflow theory for hard rock open wells by analysis of model and field data. 46th Annual Research session of CBIB.
4. KRUSEMAN, G.P. and De RIDDER, N.A 1970. Analysis and evaluation of pumping test data, Bull, 11, Int. Insti. for land Reclamation and improvement, wageningen, The Netherlands, p 200.
5. KUMARASWAMY, p. 1972. Turbulent inflow theory for hard rock open wells Govt. of Tamil Nadu, P.W.D. Irrig. Res. Stae, Poondi. Pp. 1-20.
6. NARASIMHAM, T.N. 1968. Pumping tests on open wells in Palar alluvium near Madras city, India, and application of Papadopulas-Cooper methods, Bull Inf. Assn. Sci. Hydrology, Vol. XII No.4, pp. 91-105.
7. SAMUEL, E.A. 1974. Aquifer test in large diameter wells in India, Ground water, Vol. 12, No.5, pp. 265-273.
8. SASTRI, P.G. and JANARDAN, R. 1978. Hydraulic of large diameter large wells, semi. Devp. Gwa. Res. in tribal and rural areas. A.U. WALTAIR.