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Estimation of well efficiency after well treatment: a case history in S. Korea

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In general, well efficiency (E_w) decreases with time after development and is reduced sharply at a certain time. The rapid decrease of the efficiency definitely depends upon the physical characteristics of the aquifer, chemical properties of groundwater, clogging for pore or screen, and use of groundwater well. Therefore, an adequate maintenance for the well is effective in extension of operating periods.

The proportion of agricultural wells (583,748) among the total groundwater ones (1,380,715) is 42.3% in 2011, S. Korea. Groundwater use accounts for 1.9 billion m^3/year which indicates 48.9% of total amount available groundwater resources. Total agricultural public wells are about 27,980 in 2014 and they placed in crystalline rock aquifer.

In the study, we analyzed well efficiency using data from aquifer test such as step-drawdown test and long-term pumping test for several agricultural groundwater wells before and after treatments including air surging, electric pulse discharge, and power bubble for the purpose of increasing well efficiency. Well efficiency can be calculated for each step using B (aquifer loss coefficient) and C (well loss coefficient) on the basis of the equation ($s_w/Q = B + CQ$) from specific drawdown (s_w/Q) and pumping rate (Q)[1][2]. Therefore, well efficiency is expressed by the equation ($E_w = 100/[1+(C/B)Q]$).
Moreover, transmissivity change is evaluated before and after treatments using the data from long-term pumping test.

Well efficiency was increased by an average of about 4.3% and electric pulse discharge, air surging, and power bubble approaches were improved by 4.6%, 5.0%, and 2.6%, respectively. Transmissivity was also increased to 21% compared to situation before treatment and electric pulse discharge, power bubble, and air surging approaches were improved by 25%, 21%, and 16%, respectively.

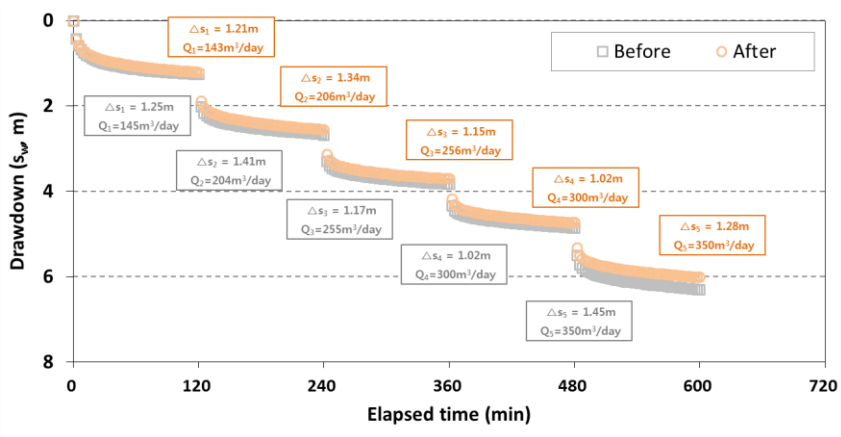

Figure 1: Step-drawdown pumping test before and after electric pulse discharge

In this study, the increase of well efficiency before and after treatments including air surging,

electric pulse discharge, and power bubble for agricultural groundwater wells with the data of step-drawdown test was evaluated, respectively. From the results, well efficiency increased approximately 2.6 to 5.0% depending on pumping rate when the proper treatment methods to the wells were applied.

References:

[1] Jacob CE (1947) Trans Ame Soc Civ Eng 112(2312): 1047-1070
[2] Bierschenk WH (1963) Int Assoc Sci Hyd (64): 493-507