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EXTENDED ABSTRACT

Calibration of the Guelph Permeameter Method Using Shallow Well Pump-in Test (SWPT) for Hydraulic Conductivity Measurement and Derivation of single depth Laplace and Richards Equation for a Loam Soil

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Introduction

Saturated hydraulic conductivity is a vital soil propriety in controlling infiltration and runoff, drainage, extracting pesticides, and herbicides from soil profile and transfer them to ground water. The auger-hole method is the most famous and the most common method to measure the hydraulic conductivity (K) that have been used normally for years. Using this method is possible where the water table is high and in a one-meter range from the soil surface. In the measurement of saturated hydraulic conductivity some problems occur when the water table of the soil is very deep. In arid and semi-arid areas especially in summer, the water table is so low making it impossible to use ideal methods. To determine the hydraulic conductivity rates of soils above the water table, different methods are used. These methods have always been faced with weakness in theoretical bases or practical problems as well as being time consuming and costly. One of these methods is the shallow well pump-in test which is the most adaptable method used for this purpose. However, a new method has been developed to measure the hydraulic conductivity above water table which is called the Guelph Permeameter method. As the Guelph method was introduced by Reynolds and Elricks (1985), great changes have been made in this field, and due to the strong theoretical bases, being less time-consuming and cheaper to perform, Guelph method attracted lots of attention. The aim of this research was to calibrate the Guelph Permeameter for the measurement of saturated hydraulic conductivity using the Shallow Well Pump-in Test (SWPT) method at an experimental farm in Shahid Chamran University of Ahvaz. This research examines the calibration of Guelph Permeameter method by using shallow depth pumping test method for a loam soil in this region.

Materials and Methods

The research was conducted in the experimental farm of Water Science Engineering Faculty of Shahid Chamran University of Ahvaz. For this research, some auger holes 30 and 60 centimeters deep were excavated in 5 meter intervals and altogether contained an area of 0.8 hectares. In order to

conduct the Guelph Permeameter test, 20 auger holes with different names were excavated with the intended depths and 5 auger holes with a depth of 1 meter were dug out in order to conduct the shallow depth pumping test. Moreover, in order to specify the type of soil texture, auger holes with the depth of 1 meter were excavated in 5 points of the testing area, and soil samples were taken from depths of (0-30) centimeters, (30-60) centimeters and (60-100) centimeters to be analyzed. After ramming and sieving the soil by hydrometric method, the percentage of its constituents were specified. Table (1) shows the results of the soil texture analysis.

Table (1). Results of Soil Texture Analysis

Type of soil texture	٪ clay	٪ Loam	٪ Sand	Depth of soil (cm)	Experiment location
Loam	22.1	41.80	36.1	0-30	Shahid Chamran University of Ahvaz
Loam	18.44	41.52	38.04	30-60	
Loam	18.95	42.00	38.35	60-100	

Results and Discussion

The soil texture in this farm was loam. 20 wells with depths of 30 and 60 were used for the Guelph permeameter method, and 5 wells with a depth of one meter for (SWPT) method. The results indicated that at the Shahid Chamran University farm, there were 11 negative value of saturated hydraulic conductivity (K_{fs}) and ϕ_m . A single analysis of Laplace (K_L) assuming zero capillarity and a single analysis of Richards with $\alpha^* = 12$ and regression based Richards method (K_R) were used for resolving the negative values. It was noticed that the geometric means for the regression based on Richards and the double depth method of Guelph were equal. It was also noted that the regression based on Richards's method had a lower standard deviation compared to other methods especially the two depth method. Coefficient for this analysis were derived using minimum square and mean α^*. It was shown in this research that for correct results, regression based on Richards method can be used and due to a high standard deviation of α^* values, it is better to table it as constant. The results showed that a loamy soil hydraulic conductivity with SWPT method was 80% higher than the Guelph method. Therefore, values of K from Guelph Method should be multiplied by 4.87 in loamy soils to be comparable to SWPT method results.

Reference

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