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Hydraulic conductivity of Na, Mg, Ca and their different types of soil mixture with distilled water

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ABSTRACT

In this present work, we have studied the hydraulic conductivity of soils in Na, Mg, Ca and their Different types of soil Mixture under different condition with distilled water. Different types of soil samples have been collected from the specific area of the Gujarat state like Ahmedabad, Surat and Ghandhidham. In this work, mixed soil samples were prepared and Study of hydraulic conductivity has been measured with distilled water.

Introduction

Hydraulic Conductivity mostly affects the seed germination and many times seeds are not germinated and ultimately farmers suffer from the economics problems. Present study will be helpful to the farmers will get great help in farming successfully, particularly the above crops.

The importance of soil- water system in the nature and in the life of human beings is as old as civilization and awareness' of mankind about his surroundings. Today no less than ancient times man ultimately depends on soil-water system and the plant life which it supports.

There are three major types of clay minerals:

Kaolinite, which is common in nature weathered soils, Montmorillonite and Illite which are the chief constituents young soil. According to Brindley[1] Kaolinite consists of sheets of oxygen atoms linked to sheets of silica and aluminum atoms i.e. oxygen atom is mutually shared by the silicon and aluminium atoms and thus the clay are known as 1:1 clay. According to Hofmann, Endeel and wilm[2] Montmorillonite group is characterized by having two silica and one aluminium sheet each group of sheets bound together by oxygen atoms (2:1 clay) According to Grim, Bray and Bradley[3] , Illite consists of two silica sheets to one of alumina,There is isomorphous substitution of Al, Mg and Fe in the alumina sheets.

In many soils, the hydraulic conductivity does not remain constant. According to Reeve et. al[4] and Brooks et.al[5], Various chemicals, physical and biological processes play an important role in the hydraulic conductivity.

Materials and Methods:

In this present work, soil samples of Surat, Ahmadabad and Gandhidham have been collected. The soil of Surat is K-M-I (Kaolinite) type, the soil of Ahmedabad is (Montomorillonite) type and the soil of Gandhidham is K-I (Iolite) type.

Soil sample were collected from each location of above mention cities, hydraulic conductivity has been measured with distilled water, which were affected with salinity.

Saturated flows (saturated conductivity) in Saturated Soils and unsaturated flow (capillary conductivity) in soils are unsaturated. However Slatyer[6] concludes that the term hydraulic conductivity formerly used for water in saturated soils is now used for both saturated and unsaturated flow. Wheeler, S.J.etal[7] the Coupling of various mixture of soils the hydraulic conductivity behaviour in unsaturated soils.

McNeal et.al [8] and Anil kumar Mishra et.al [9] showed that mixed Na-Mg soils developed lower hydraulic conductivity than Na-Ca soil under similar condition.According to Bakker and Emerson[10], Emerson and chil [11] and Shainberg et.al [12], the montmorillonite and illite are more easily dispersed in the presence of Na and Mg compares with Na-Ca.

The main difference is that in saturated soils gravity controls the water potential gradient, while in drained soils, it is controlled by the potential and water moves in films surrounding the soil particles rather than by gravity flow through the pores The theory of movement of liquid water is based on a generalized form of Darcy's Law, which states that the quantity of water passing through a unit Cross-Section of Soil is proportional to the difference in hydraulic head. The discharge rate 'Q', the Volume being 'V' flowing through the column and per unit time 't', is proportional to the Cross-Section area 'A' to the hydraulic head drop 'ΔH' and inversely proportional to the length of column 'L' :

$$Q = V/t \propto \frac{A\Delta H}{L}$$

The common way to determine the hydraulic head drop across the system is to measure the head at the inflow boundary

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(Hi) and at the out flow boundary (Ho), relative to some reference level. 'ΔH' is the difference between these two heads, obviously no flow occurs ΔH= 0 he head drop per unit distance in the direction of flow (H/L) is the hydraulic gradient, which is the driving force. The Specific discharge rate Q/A (i.e. the volume of the water flowing through Cross – Section area 'A' per unit time 't' is called the flux density and is symbolized by 'q' A hysteresis behavior has been confirmed by Poulovassilis.[13] Thus, the flux is proportional to the hydraulic gradient :

$$q = Q/A = V/At \propto \frac{H}{L}$$

This equation is known as Darcy's Law. The hydraulic conductivity of soil samples calculated by following equation.

$$q = K\{ H_1/L + 1 \} \ \& \ q = K\{ H_1/L - 1 \}$$

Results and Discussion:

Hydraulic conductivity of various distilled water in Normal Soils, Na-Soil, Mg- Soil, Ca-Soil represented Table:-1

On comparison, the data of hydraulic conductivity for normal soils are generally low (Table:-1)

For K-M-I, Na soils have the highest hydraulic conductivity, next in order comes the Ca soils.

The lowest hydraulic conductivity is found in Mg soils.

Hydraulic Conductivity of Na:Mg and Mg: Na and their various mixture with Distilled Water shown on Table :- 2 , 3.

Hydraulic Conductivity of Na:Ca and Ca:Na and their various mixture with Distilled Water shown on Table :- 4 , 5.

Hydraulic Conductivity of Ca:Mg and Mg:Ca and their various mixture with Distilled Water shown on Table :- 6 , 7.

It is found that Hydraulic Conductivity for Na-Mg soils of K-M-I type is lower than the Na-Ca soils of K-M-I type. In the case of M type soils Hydraulic Conductivity of Na-Mg soils are lower for Na:Mg 20:80 and 30:70, but comparatively much higher for the Na:Mg 40:60,which is perhaps the higher value even when compare to Na-Ca at all the levels, i.e.20:80, 30:70, and 40:60.The K-I clay type of soil has very poor conductance for Na-Mg soil at all levels i.e. 20:80, 30:70, 40:60 but the value improve for Na-Ca at 20:80 mixing.Thus Na-Mg & Na-Ca soils shows variability in behaviour.

According to Okamoto,et al [14] data in table:-6 indicates the value for K-I type soils improve in their Hydraulic Conductivity in proporation of the increase in Mg soil. data in table:-7 indicates decrease in Hydraulic Conductivity for K-M-I type of soil with increasing proporation of Mg. For M type of soila, the value are nearly constant, and for the K-I type of the soils also the values did not differ much more.

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Table:- 1. Hydraulic Conductivity of Normal Soils, Na-Soil, Mg- Soil, Ca-Soil with Distilled Water

Days	Normal Soils			Na-Soil			Mg- Soil			Ca-Soil		
	K-M-I	M	K-I	K-M-I	M	K-I	K-M-I	M	K-I	K-M-I	M	K-I
1	21.04	8.98	6.82	55.02	67.41	2.04	15.71	11.09	2.16	20.82	8.92	13.71
2	8.96	9.14	4.51	43.52	49.52	2.32	20.78	2.92	4.19	46.81	4.44	5.92
3	9.68	10.2	2.44	89.09	37.11	2.18	11.72	0.98	3.21	36.83	3.31	4.62
4	8.05	11.3	2.06	85.90	30.41	1.05	10.72	0.14	1.19	27.15	3.28	4.61
5	4.72	9.13	1.08	9.96	14.09	1.05	8.70	0.00	0.94	19.62	2.32	2.38
6	2.37	4.01	1.08	1.82	9.05	1.05	8.70	0.00	0.00	19.63	1.19	2.38
7	2.39	2.41	1.08	1.81	4.91	1.05	8.51	0.00	0.00	25.71	1.37	2.11

Table:- 2. Hydraulic Conductivity of Na:Mg =20:80, Na:Mg =30:70, Na:Mg =40:60 with Distilled Water

Hydraulic Conductivity K cms / day									
Days	Na:Mg=20:80			Na:Mg=30:70			Na:Mg=40:60		
	K-M-I	M	K-I	K-M-I	M	K-I	K-M-I	M	K-I
1	16.93	15.11	3.13	7.51	18.21	3.23	7.04	20.31	1.91
2	9.11	8.16	1.98	7.51	6.51	2.12	5.09	7.81	2.07
3	7.14	5.12	0.97	3.76	3.27	2.34	2.63	4.49	1.93
4	5.21	3.10	0.98	2.98	2.05	3.31	2.05	5.64	2.15
5	4.27	1.98	0.98	2.52	1.05	1.19	2.06	4.53	0.98
6	3.32	1.05	0.00	2.22	1.05	0.96	1.62	4.53	0.00
7	3.31	0.00	0.00	2.32	1.05	0.00	1.61	4.52	0.00

Table:-3. Hydraulic Conductivity of Mg :Na =20:80, Mg :Na =30:70, Mg :Na = 40:60 with Distilled Water

Hydraulic Conductivity K Cms / Day									
Days	Mg:Na =20:80			Mg::Na =30:70			Mg:Na =40:60		
	K-M-I	M	K-I	K-M-I	M	K-I	K-M-I	M	K-I
1	23.02	18.30	2.24	28.62	17.62	1.94	34.83	16.32	1.34
2	17.82	15.58	3.72	13.42	15.33	2.36	19.92	14.04	2.12
3	11.12	10.12	4.18	9.82	11.64	3.72	15.05	8.51	2.04
4	6.62	6.54	2.25	9.63	8.04	2.08	15.05	7.88	0.00
5	4.68	5.57	1.08	5.52	6.12	0.96	10.04	3.22	0.00
6	3.38	4.32	1.04	5.52	3.27	0.00	10.04	2.20	0.00
7	3.38	2.24	1.04	5.52	2.04	0.00	10.04	2.20	0.00

Table:- 4. Hydraulic Conductivity of Na :Ca =20:80, Na :Ca =30:70, Na :Ca = 40:60 with Distilled Water

Hydraulic Conductivity K Cms / Day									
Days	Na:Ca =20:80			Na:Ca =30:70			Na:Ca =40:60		
	K-M-I	M	K-I	K-M-I	M	K-I	K-M-I	M	K-I
1	19.62	10.23	14.98	15.03	16.06	12.07	58.43	18.91	8.92
2	9.42	6.48	6.31	9.67	7.52	5.46	37.02	6.61	3.15
3	9.13	3.20	4.37	8.02	4.41	3.39	29.84	4.05	2.02
4	9.13	1.91	3.16	7.11	3.42	4.91	10.02	3.42	0.93
5	6.54	1.91	2.05	6.82	2.98	2.13	10.03	3.42	1.08
6	5.92	0.87	2.05	4.62	2.92	2.02	9.04	3.42	1.08
7	5.92	0.83	1.27	4.32	2.94	0.91	8.92	3.42	0.31

Table:- 5. Hydraulic Conductivity of Ca :Na =20:80, Ca :Na =30:70, Ca :Na = 40:60 with Distilled Water

Hydraulic Conductivity K Cms / Day									
Days	Ca:Na =20:80			Ca:Na =30:70			Ca:Na =40:60		
	K-M-I	M	K-I	K-M-I	M	K-I	K-M-I	M	K-I
1	12.62	28.38	6.72	10.81	18.34	5.34	17.82	15.31	6.32
2	9.82	15.38	3.09	15.24	9.82	4.32	16.28	9.78	5.48
3	4.08	9.93	1.84	5.02	8.63	3.08	6.24	6.21	3.98
4	4.11	3.32	2.13	5.02	3.19	1.74	5.42	4.02	3.18
5	2.13	2.22	0.92	3.17	1.82	1.74	6.24	2.06	1.72
6	2.13	2.22	0.62	3.18	1.82	0.92	5.82	2.78	1.72
7	2.13	1.93	0.62	3.17	1.82	0.92	5.42	2.82	1.83

Table:- 6. Hydraulic Conductivity of Ca : Mg =20:80, Ca :Mg =30:70, Ca : Mg = 40:60 with Distilled Water

Hydraulic Conductivity K Cms / Day									
Days	Ca:Mg =20:80			Ca:Mg =30:70			Ca:Mg =40:60		
	K-M-I	M	K-I	K-M-I	M	K-I	K-M-I	M	K-I
1	12.14	10.02	8.93	47.98	6.52	5.51	18.28	7.91	3.42
2	7.98	3.21	2.82	13.20	4.27	2.31	7.90	2.23	1.98
3	3.96	1.98	2.52	5.89	3.32	2.04	5.72	1.13	1.02
4	3.46	1.02	2.04	3.62	1.16	2.32	3.82	2.28	0.00
5	2.92	0.00	0.98	3.04	1.06	1.04	3.29	0.98	0.00
6	2.92	0.00	0.00	2.96	0.00	0.00	3.36	1.02	0.00
7	2.92	0.00	0.00	2.96	0.00	0.00	3.36	0.00	0.00

Table:- 7. Hydraulic Conductivity of Mg : Ca =20:80, Mg : Ca =30:70, Mg : Ca = 40:60 with Distilled Water

Hydraulic Conductivity K Cms / Day									
Days	Mg:Ca=20:80			Mg:Ca =30:70			Mg:Ca =40:60		
	K-M-I	M	K-I	K-M-I	M	K-I	K-M-I	M	K-I
1	34.88	7.61	9.02	30.22	6.53	6.23	21.58	9.02	6.98
2	32.30	4.32	4.28	19.04	2.41	3.30	15.54	5.58	4.44
3	26.54	5.27	2.25	15.52	4.68	2.10	10.08	2.31	2.28
4	15.42	3.38	1.14	15.04	4.54	2.34	8.51	2.16	2.12
5	15.64	2.10	1.29	11.02	3.30	1.36	7.76	2.16	2.12
6	13.92	2.10	1.29	11.02	2.08	1.26	7.76	1.08	2.36
7	12.38	1.02	1.16	11.02	2.08	1.10	7.76	1.08	2.08