

# Experimental Investigation to Determine Infiltration Rate in Soil Using Double-Ring Infiltrometer Method

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**ABSTRACT:** An attempt has been made in the present work to evaluate infiltration characteristics of soil at Gubbi near the water bodies using a Double ring infiltrometer. Experimentation work is carried out at Three points in the Gubbi. The study aimed at determining the constant infiltration rates of those soil using the Double ring infiltrometer and calculate the infiltration rate by using horton's infiltration equation.

**KEYWORDS:** Infiltration, Double ring infiltrometer, infiltration rate

## I. INTRODUCTION

Infiltration is the process by which water on the ground surface enters the soil. Infiltration rate in soil science is a measure of the rate at which a particular soil is able to absorb the rainfall or irrigation. It is measured in inches per hour or millimeter per hour. The rate decreases as the soil becomes saturated. A soil that is in poor condition does not allow to enter the soil, and it flows down slope as runoff. A prolonged runoff can lead to poor water storage in the soil for plants to grow. It can also lead to soil erosion, which carries away sediments, organic matter and nutrients from the soil to the streams, lakes and rivers. Infiltration of water into the soil can be determined by a simple instrument called Double ring infiltrometer. The double ring infiltration is suitable for almost any type of soil with the exception of clogging soils, stony soils or the soil of steep slopes. The outer ring causes almost vertical infiltration of water from the inner ring. A number of soil-hydrological features can be determined: Infiltration capacity, near-saturated hydraulic conductivity Infiltration curve.

### 1.1 Objectives of Double ring infiltrometer

- Cumulative infiltration over a certain period. The double ring infiltrometer is applied, among other things, in determining the infiltration capacity of flooded for:
  - Surface irrigation and drainage projects
  - Infiltration or water purification basins, Seepage from water courses, canals basins or waste water lagoons
  - leaching at waste storage sites.
  - Research into the effect of cultivation.
  - Research into drainage effects.
  - Research into badly permeable layers of sports fields

### 1.2 Materials and experimental programs

- 2 Number of cylindrical ring infiltrometer (outer ring dia.60cm and inner ring dia. 30cm, height =25cm)
- Wooden piece (to drive the cylinder inside the soil)
- Hammer (to dig the cylinder inside the soil without any disturbance in the soil surface)
- Measuring bucket
- Measuring rod
- Metal plate
- Stopwatch
- Cover and plastic sheet
- Washcloth and water

## II. METHODOLOGY

The two cylinders are digged inside the soil but the measurement is taken in the inner cylinder only the outer cylinder helps the water from the inner cylinder to flow vertically downwards and not laterally. The cylinders are of height 25cm which are been digged up to a height of 15cm inside the soil with the help of steel rod and hammer. Figure 1 shows the infiltrometer that has been used in this experiment with inner diameter 30cm and outer diameter 60cm.



Fig 1: Double ring infiltrometer

Cylinders are kept back 10cm above the ground surface in which the water was poured and the measurement of the decreasing water level was taken. Water is supplied uniformly inside the ring without any disturbance of soil surface. A measuring scale of 30cm is placed in the inner cylinder and the initial water level of the inner cylinder is noted down. The measurement was continued until and unless a constant value of infiltration rate was achieved. A time interval of two minutes and later four minutes and a total of 65 minutes were taken and the decrease in the water level was measured. The water level in the outer cylinder is kept at the same level as the water level in the inner cylinder.

## III. DATA OBTAINED IN EXPERIMENT AND CALUCLATION

### 3.1 IN HARUR LAKE

Time in 'minutes	Initial water level in (mm)	Final water level in (mm)
0	7	7
5	7	7
10	7	6.8
15	6.8	6.8
20	6.8	6.7
25	6.7	6.6
30	6.6	6.6
35	6.6	6.5
40	6.5	6.5
45	6.5	6.4
50	6.4	6.4
55	6.4	6.4
60	6.4	6.4
65	6.4	6.4

#### Formula and calculation

By using Horton's equation

$$f_t = f_c + (f_0 - f_c)e^{-kt}$$

Where,

F<sub>0</sub> = initial reading

F<sub>c</sub> = final reading

F<sub>t</sub> = infiltration rate at any time



For time 15min  
 $f_{15} = 6.8 + (7 - 6.8) * e^{-1(0.25)} = 6.81 \text{mm/hr}$   
 For time 30min  
 $f_{30} = 6.6 + (6.8 - 6.6) * e^{-1(0.5)} = 6.63 \text{mm/hr}$   
 For time 45min  
 $f_{45} = 6.4 + (6.6 - 6.4) * e^{-1(0.75)} = 6.5 \text{mm/hr}$   
 For time 60min  
 $f_{60} = 6.4 + (6.4 - 6.4) * e^{-1(1)} = 6.4 \text{mm/hr}$

**3.2 IN GUBBI LAKE ( FIRST POINT)**

Time in 'minutes	Initial water level in (mm)	Final water level in (mm)
0	7	7
5	7	6.8
10	6.8	6.7
15	6.7	6.1
20	6.1	6.0
25	6.0	6.0
30	6.0	5.9
35	5.9	5.8
40	5.8	5.7
45	5.7	5.7
50	5.7	5.5
55	5.5	5.5
60	5.5	5.5
65	5.5	5.5

By using Horton’s equation  
 $f_t = f_c + (f_o - f_c) e^{-kt}$   
 For time 15min  
 $f_{15} = 6.1 + (7 - 6.1) * e^{-1(0.25)} = 6.182 \text{mm/hr}$   
 For time 30min  
 $f_{30} = 5.9 + (6.1 - 5.9) * e^{-1(0.5)} = 5.9 \text{mm/hr}$   
 For time 45min  
 $f_{45} = 5.7 + (5.9 - 5.7) * e^{-1(0.75)} = 5.7 \text{mm/hr}$   
 For time 60min  
 $f_{60} = 5.5 + (5.7 - 5.5) * e^{-1(1)} = 5.57 \text{mm/hr}$

**3.3 GUBBI LAKE (SECOND POINT)**

Time in 'minutes	Initial water level in (mm)	Final water level in (mm)
0	7.8	7.8
5	7.8	6.6
10	6.6	6.0
15	6.0	5.9
20	5.9	5.8
25	5.8	5.5
30	5.5	5.3
35	5.3	5.1
40	5.1	4.9
45	4.9	4.5
50	4.5	4.5
55	4.5	4.3
60	4.3	4.2
65	4.2	4.2

By using Horton's equation

$$f_t = f_c + (f_0 - f_c)e^{-kt}$$

For time 15min

$$f_{15} = 5.9 + (7.8 - 5.9)e^{-1(0.25)} = 7.1 \text{ mm/hr}$$

For time 30min

$$f_{30} = 5.3 + (5.9 - 5.3)e^{-1(0.5)} = 5.41 \text{ mm/hr}$$

For time 45min

$$f_{45} = 4.5 + (5.3 - 4.5)e^{-1(0.75)} = 4.64 \text{ mm/hr}$$

For time 60min

$$f_{60} = 4.2 + (4.5 - 4.2)e^{-1(1)} = 4.31 \text{ mm/hr}$$

#### IV. TABULAR COLUMN OF FINAL RESULTS

Time in 'min'	Rate of infiltration in mm/hr and Place		
	Heruru Lake	Gubbi Lake	Hanumanthanagara near Gubbi Lake
15	6.81	6.18	7.1
30	6.63	5.9	5.41
45	6.45	5.7	4.64
60	6.4	5.57	4.31



Fig 2: Some photographs while carrying out the experiment on sites

#### V. RESULTS AND DISCUSSION

Table shows the infiltration rate for the different site we can see that hanumanthanagara near Gubbi Lake has the highest rate of infiltration than the other Two study areas and Heruru Lake has the lowest infiltration rate. In



hanumanthanagara and other Two points are the infiltration rate at the beginning was high and decreased to reach the steady (constant) where else Heruru has lowest infiltration rate.

In the beginning the infiltration rate is high as the soil is in the dry state and slowly as the soil saturates it decreases and finally gets a constant value. This may be attributed to the fact that infiltration rate depends on soil characteristics. It is found that for loamy soil the type of infiltration is slow-moderate, for sandy loam soil the type of infiltration is moderate whereas, for sandy soil we got moderate-rapid rate of infiltration.

## **VI. CONCLUSION**

From research work it was found that soil conditions effects infiltration rate. In filtration rates against time it is found that initial infiltration rates were high and decreased with time up to constant infiltration rate. The studies in these three places of Gubbi says how the rate of infiltration various from place to place depends upon the types soil.

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